THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 254.

ELECTRICAL NAVIGATION.

We have recently had sent to us a small illustrated pamphlet of an interesting character, written by M. Georges Dary, who is evidently a great admirer of the eminent French electrician, M. Trouvé. The little work has its pages devoted to the electrical inventions and ideas of Trouvé, but it deals more particularly with the matter of electric navigation, for which purpose the well-known Trouvé electro-motor was more especially designed. The idea of propelling vessels by means of electricity has been a subject to which many electricians of the past and present have turned their serious attention, and it has just received an addition to its history which will probably form a starting point for an immediate development of this method of propulsion. In the *Times* of the 29th ult., there appeared a letter bearing the signature of Professor Silvanus Thompson, describing the trial trip of an electric launch very appropriately named *Electricity*, and which he states to be the first ever propelled upon the waters of the Thames by the motive-power of electricity. The little craft, on board of which Prof. Thompson formed one of a party of four, is 25 ft. in length, about five ft. in the beam, draws about two ft. of water, and is fitted with a 22-in. propelling screw.

Two dynamo-electric machines, known as the D^3 Siemens', were furnished with proper reversing gear and regulators to serve as engines to drive the screw propeller, and either or both of these could be switched into circuit at will. The current for actuating these machines was supplied by 45 secondary cells of the Sellon-Volckmar type, and when fully charged they were calculated to supply force for six hours at the rate of four horse-power. The little vessel started from the wharf of the Electrical Power Storage Company at Millwall, and was propelled citywards at the rate of about eight knots an hour against tide.

She reached London Bridge at 4 h. 37 m., and was then put about, returning on the ebb to Millwall at 5 h. 1 m., the return journey, therefore, occupying just 24 minutes. The distance between these two points is, roughly speaking, about 3¼ to 3½ miles. Professor Thompson adds for the benefit of electricians that the total electromotive force of the 45 accumulators was 96 volts, and that during the whole run the current through each machine was steadily maintained at 24 ampères. He calculates that this corresponds to an expenditure of electrical energy at the rate of 3 1-11ths horse-power.

M. Georges Dary, in his pamphlet, states that on the 26th May, 1881, the passers-by stopped in crowds upon the bridges to look with astonishment at a light craft, in the midst of the numerous river steamers which plough the Seine in Paris, which went up the stream without any visible motor. It was stopped, resumed its progress, or slackened, without any observable movement of its steersman, who appeared motionless at the stern. It was not long before it was learnt that this was a new application of electricity, coupled with the name of M. Trouvé and his electro-motor. This apparatus is well known to all those who visited the Paris Electrical Exhibition of 1881.

To the Russian Professor Jacobi belongs the honour of attempting to propel a boat by means of electricity for the first time. M. Jacobi compiled in 1834 a report, which he presented to the Academy of Sciences of St. Petersburg, on electro-magnetism applied to machinery.

In 1839 the Czar Nicholas allowed 60,000 francs to M. Jacobi, and ordered him to construct a primary electric motor, and to adapt it to a boat. The machine, composed of electro-magnets which communicated motion to two wheels with armatures, was actuated by a Grove battery of 128 couples.

The invention was apparently successful, and the boat traversed the River Neva to the great admiration of the spectators. The experiment, however, eventually turned out to be a failure, and Jacobi himself looked upon the question as insoluble. Twenty years later another attempt at electrical navigation took place on the lake in the Bois de Boulogne, which however turned out as unfortunate as its predecessor. The failure in both cases may be attributed to two causes: the use of ordinary galvanic batteries, and the want of such dynamo-electric machines as we now possess. Probably, had it been in the power of Jacobi or his successor to have had at command Planté's, Faure's, or the Sellon-Volckmar secondary cells, the crude motors of those days might have been made to give better results; and on the other hand, had our present dynamo-electric machines been in existence, then ordinary galvanic batteries could have been employed to more advantage. In neither case, however, could commercial success have been attained, for the dynamo is as necessary to charge the accumulators cheaply as it is to act as a motor.

We may therefore agree with M. Dary that true electrical navigation dates from the first experiment with the Trouvé boat. Experience has always shown that discoveries of such a nature as that we are now dealing with require years of labour before the highest degree of perfection of which they are susceptible is attained. We look with satisfaction on what has been already accomplished during the last year or two in electrical navigation, and if the hope existed in years gone by that the application of electricity to this purpose might be extensively employed, how much more may we now cherish the belief in the face of the present investigations that the future belongs to electricity; or, quoting the words of Prof. Thompson, "who shall say to what proportions this latest application may not attain in the next decade."

Since penning the above lines we have been favoured by Prof. Thompson with further details concerning the *Electricity*, which will be found in our "Notes" columns; and on Thursday morning, through the courtesy of the Electrical Power Storage Company, we had the pleasure of a trip from Millwall to London Bridge, the little vessel being in charge of Mr. Philippart, jun., to whom we desire to return our best thanks for the attention we received at his hands, and also for information imparted to us respecting the various points of interest connected with the working of the launch.

ATTRACTION AND REPULSION DUE TO SONOROUS VIBRATIONS, AND A COMPARISON OF THE PHENOMENA WITH THOSE OF MAGNETISM.*

Prof. Guthrie's question as to whether *attraction* were changed into *repulsion* by the removal of one of the vibrating membranes to the extent of half a wave length, is one to which I gave some attention at the commencement of my research. It is perfectly reasonable to expect such an effect, and I have alluded to it in my paper, but being at the time in search of other effects, I did not further pursue my investigation in that direction.

Mr. Preece was quite right in suggesting that two membranes standing opposite each other and vibrating in opposition to one another, as shown in fig. 8 of my paper, might be said to be in *opposite* phase, instead of being in the *same* phase, as I have described; but I think we must in these experiments look upon the *effect* more than the *cause*, and when both membranes produce simultaneously alternate compression and rarefaction of the air near them, whatever be their position towards each other, we must look upon the vibrations as being in the *same* or *like* phase, with regard to the medium between them.

I understand that Mr. Preece's suggestion arose from the desire to make the analogy between the two sets of experiments *perfect*, but the last experiment described in my paper (see figs. 36, 37, and 38) shows that this cannot be done.

In this experiment, which I consider an important one, for in it two effects are combined, a little disc (fig. 36) places itself *parallel* with the axes of the drums, whose membranes are vibrating in like phase (fig. 37*a*), while it turns at *right angles* to the axes between two similar poles of magnets. In both cases it is *repelled* from the central or axial position.

Were we now to reverse the order of things and call the phase of vibration of two membranes, as represented in fig. 37*b*, the *same* or *like* phase, and compare it with two similar poles of magnets, then we should obtain certainly a position of the disc at right angles to the axes of drums or poles in *both* cases; but, between the vibrating membranes, it would be *attracted* towards the axial position, while, between magnetic poles, it would be *repelled* from the axes of the poles towards the position XX., fig. 38*a*. Therefore, by setting one difference right, another would appear, and the change of terms would not help us in any way.

Prof. Foster asked, very pertinently, what would take place when the phase of vibration of the two membranes was neither the *same* nor *opposite*, but *quarter* phase. My apparatus, as at present constructed, does not admit of the production of this effect, but I have not the slightest doubt that, in the case mentioned by Prof. Foster, there would be neither *attraction* nor *repulsion*.

All the experiments described in my paper, and which I have shown this evening, are such as can be compared with corresponding magnetic experiments; but there are others which will not compare with magnetism, and which are nevertheless interesting in connection with the investigation.

For instance, I have shown by the two cardboard discs, represented in fig. 25 of my paper that we obtain apparent *attraction*, caused probably by the momentum of the expelled air creating a partial vacuum as described; but, if by some means or other I prevent this momentum taking place, say, by placing a flange or rim round the disc (shown in fig. 39), the conditions are entirely altered. If I move such a disc with a flange to and fro in front of a suspended disc, in the manner described in the experiment (fig. 25), we obtain *repulsion*, while as soon as I remove the flange from the disc we have *attraction* again, as before.

This experiment may be varied by taking a piece of brass tubing of about 9 centimètres in diameter, and about 7 or 8 in length, into which fits loosely a wooden piston with a rod, as shown in fig. 40, and presenting one end of the tube to the suspended disc (fig. 25) while moving the piston within the tube to and fro, then the tube acts in a similar manner as the rim or flange in the previous experiment, and *repulsion* is the result; but by placing a flange or disc of about 14 centimètres in diameter, as shown in fig. 41, on the end of the tube which is presented to the suspended disc, *attraction* is again obtained. It is worth noticing that the flange in this experiment forms a flat surface at *right angles* to the axis of the tube or the piston rod, while in fig. 39, where the *opposite* effect is obtained, the surface of the flange is *parallel* with axis or rod.

A similar experiment may be made with the drum and vibrating membrane. We have seen that a single vibrating membrane will attract a disc, D, fig. 12, but when a short piece of tube is placed over the drum, so that the end of the tube projects beyond the drum and membrane to the extent of a few millimètres, as shown in fig. 42, *repulsion* of the disc, D, is the result, while a little flange of three millimètres in depth (shown in fig. 43), when placed on the end of the tube, will have the effect of converting the repulsion into *attraction* again, as before.

I may be excused here for indulging in a little speculation, viz.: We are all aware that there is no substance known at present which will insulate magnetism, or, in other words, which the magnetic lines of force will not completely penetrate. If we had, however, such a substance, and were able to make a tube of it, and place it over the pole of a magnet, in the manner shown with the drum, and thereby cause the lines of magnetic force to be altered or diverted into a different direction, *perhaps* (and I only venture to go so far as to say *perhaps*) we should obtain similar results with a magnet as those I have just shown with the disc and the vibrating membrane.

Prof. W. G. Adams, F.R.S.: Mr. Stroh has given beautiful illustrations or vortex motion in liquids and in gases. He has shown us the complete analogy between the motions of gases and the motions of liquids, as shown by the experiments of Prof. Bjerknes (which many of us had the pleasure of seeing last year in Paris), when they are set in motion by vibrating discs. He has shown us also the close analogy between the motion of such vibrating discs in the presence of liquids or gases, and the motion of a magnetic needle in a magnetic field. I would like to make a few remarks with reference to the cause of these apparent attractions and repulsions of the vibrating discs in Mr. Stroh's and Prof. Bjerknes' experiments, and to draw attention to the relation which these experiments have to the beautiful experiments of Mr. Froude, whereby he proved some years ago that when a fluid is in motion, but with different velocities in different parts, the whole amount of energy of motion of the fluid being a constant quantity, where the velocity is greatest the pressure of the fluid is least.

From the principles of conservation of energy, we should expect that, in a fluid in motion, if part of the energy is spent in increasing the velocity of the moving particles, there must be less potential energy or diminished pressure.

Mr. Froude showed this experimentally, by allowing a stream of water to flow through a pipe of varying diameter in different parts. Where the pipe was contracted, and therefore the velocity of flow increased, the pressure was diminished, and, where the pipe was largest, there the velocity of flow was least and the pressure was greatest.

Thus, if E F (fig. A) be a pipe through which a liquid is kept continually flowing, and if tubes, A, B, C, D, be inserted at various points, the height of the liquid in these tubes will indicate the pressures at the several points, and these heights will be found to be least where the pipe is smallest—*i.e.*, where the velocity is greatest.

Now let us see what bearing this principle has on Mr. Stroh's experiments. If we take the case of the vibrating disc, which is attracted when the back of the hand or a disc not in vibration is presented to it, immediately in front of the centre of the disc, the changes of velocity of motion of the fluid are the greatest, and the mean square of the velocities has its greatest value, and hence the average pressure in this position is less than in other parts of the fluid.

In going out from the centre of the disc in any direction, the average velocity diminishes, and, as the energy of motion depends upon the square of the velocity, and will therefore be the same whether the motion be backwards or forwards, the average pressure will gradually increase until we reach that portion of the fluid which is not in vibration. The external pressure on the tube and support of the disc being

* Supplement to Paper read by A. Stroh before the Society of Telegraph Engineers and of Electricians, April 27th, 1882.

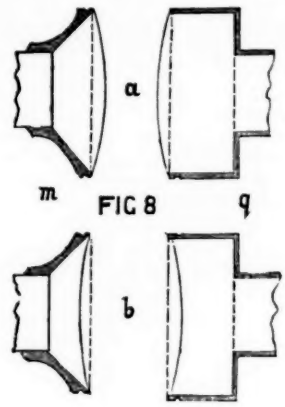


FIG 8

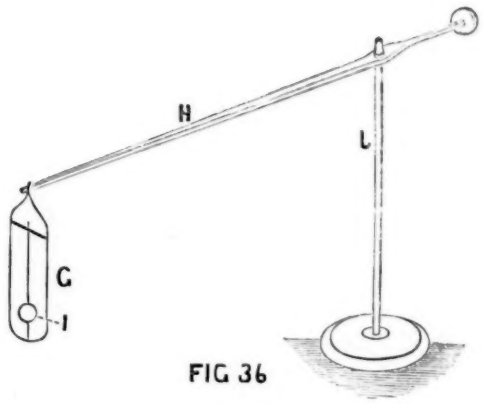


FIG 36

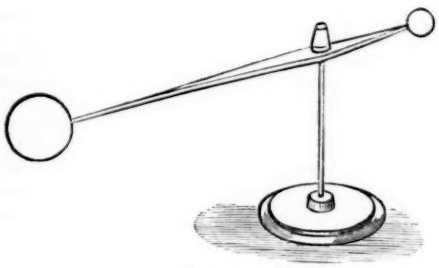


FIG. 12.

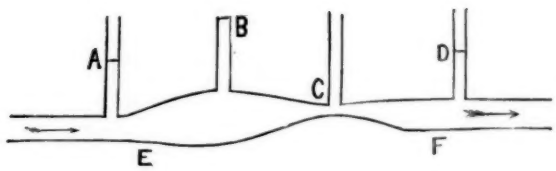
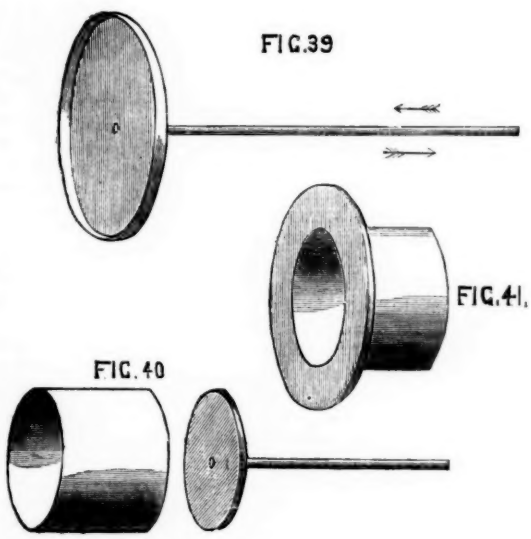
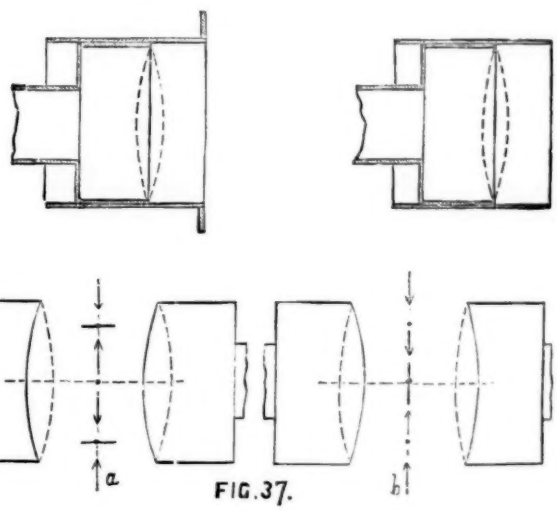


FIG. A.

FIG. 43.

FIG. 42.





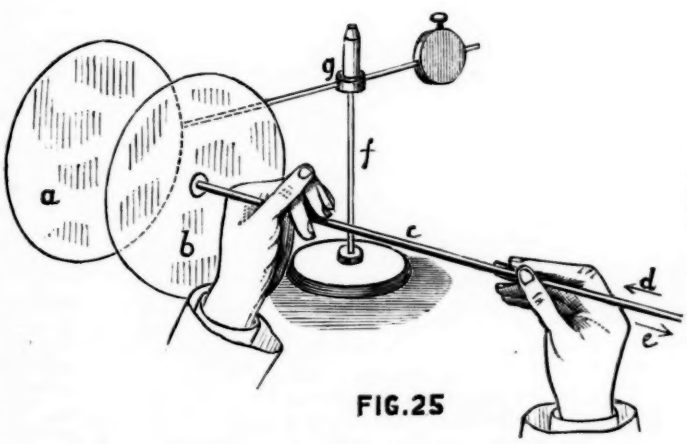


FIG.25

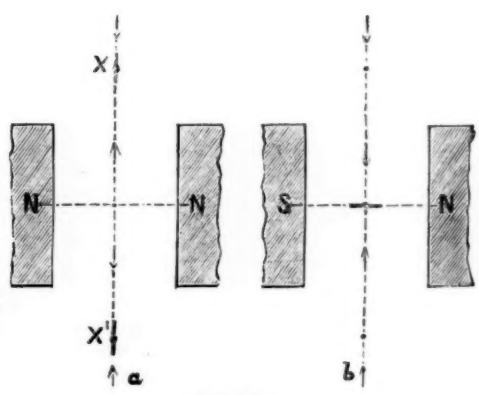


FIG.38

greater than the pressure immediately in front of the disc, the disc will move forward.

Take, again, the case of attraction of discs at the ends of two tubes placed opposite to one another, and both vibrating inwards or both outwards at the same instant (discs which Mr. Stroh describes as being in the same phase). In this case, in the experiment with glycerine and a coloured liquid, we saw (and I hope members noticed this point in the experiment) that the vortices were moving with different velocities in different parts of the four quadrants in which the symmetrical states of motion were set up. The velocities were greatest immediately in front of the discs where the threads of coloured liquid became suddenly drawn out, and hence we should expect that these were positions of least pressure, and that the resultant pressure in front of the discs is less than behind them, and consequently the discs will move towards one another. The thread of coloured liquid came slowly up along the face of the disc towards the centre, and the velocity gradually increased to its greatest value as the thread bent round to move in a direction perpendicular to the faces of the discs—outwards. In this central position, then, the pressure reached its least value, and the resultant pressure of the surrounding liquid caused the discs to move towards one another.

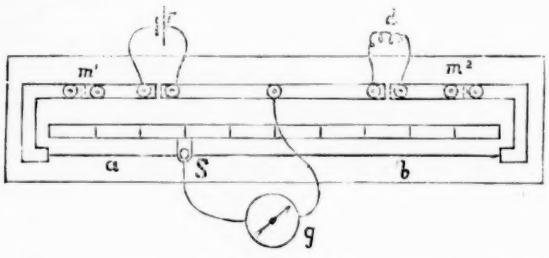
If there were any liquid or any substance by the vortex motions in which we could suppose magnetic effects to take place, then we should have a most complete analogy between these motions and the action of magnetic poles on one another.

In the case of gases, I apprehend that the cause is the same as in the case of liquids, that in fact the result has more to do with the actual motion of the gas than the change of density taking place in the gas itself, although both conditions of course are present.

MEASUREMENT OF BATTERY RESISTANCE BY MANCE'S METHOD.*

By H. R. KEMPE.

The resistance of a battery cell can be measured with a considerable degree of accuracy by means of the slide wire bridge, employing Mance's method. The figure shows the arrangement.



The general method of procedure is as follows: Having made the connections as shown (the gaps, m_1, m_2, being closed with the thick copper latches), the slide, S, is moved along the scale, the key being depressed at intervals, until the point is reached at which the depression of the key makes no change in the permanent deflection of the needle. When this is the case then

$$r = d\left(\frac{a}{1{,}000 - a}\right)$$

Thus, for example, suppose $d = 1$ ohm and $a = 450$ divisions, then

$$r = 1\left(\frac{450}{1{,}000 - 450}\right) = \frac{450}{550} = \cdot 82 \text{ ohms.}$$

Generally speaking the test is simple enough, but there are several points which must be attended to in order that a correct result may be obtained. In the first place it is necessary that the resistance, d, be greater than the resistance of the battery, though it should not be greater than about ten times the value of the latter. As a rule the complete slide wire bridge is furnished with four resistance coils of one ohm each, so that the choice of a resistance to insert in d is limited, and it may not be possible to follow out the rule of "making d larger than r, but not greater than about 10 times r." In this case the possibility of an accurate measurement becomes proportionally reduced below the highest possible standard, so that on the one hand a cell whose resistance is much less than one-tenth of an ohm or, on the other hand, a cell whose resistance exceeds four ohms, cannot be measured with the highest possible accuracy.

Strictly speaking, in order to insure accuracy it is necessary that the resistance of the portion of the slide wire, a, be less than the resistance of the battery to be measured; but as the resistance of the whole length of the wire will not exceed one-tenth of an ohm, the resistance of the length, a, will practically be less than the resistance of the battery, unless, of course, this resistance is extremely low. Assuming, however, that it is, say, five or six times greater than the resistance of the battery; then the next point to be seen to is that the deflection of the galvanometer needle does not exceed about 60°, nor is less than about 40°, for the success of the test depends upon a change in the current through the galvanometer being as perceptible as possible, and this would not be the case if the deflection was outside the limits laid down. If the deflection is too low then the only thing to be done is to employ a more sensitive galvanometer; but if the deflection is too high the galvanometer may be shunted until the deviation is brought within the limits mentioned. *In any case it is very necessary to employ a galvanometer whose needle is very freely suspended*, that is to say, *a galvanometer whose needle when deflected will change with a very slight change in the current strength.* It must not be supposed that by this we mean a very *sensitive* galvanometer in the ordinary understood sense of the term, that is to say, a galvanometer whose needle will deflect several degrees from zero with a very weak current; such a galvanometer may be perfectly useless for a test like Mance's. Practically, it may be taken that the only galvanometer of use for such a test is one with a needle suspended from a fibre; but there is not the slightest necessity for the instrument being a *sensitive* one as long as we can get a deflection of between 40° and 60°, when the apparatus is joined up to the bridge. A *compass* suspended needle, unless the pivoting is extremely good, is almost useless, no matter how *sensitive* it is to a weak current.

Provided the conditions laid down be perfectly followed out, and provided the slider is set so that on its depression the galvanometer needle does not change its deflection more than one quarter of a degree, then we can practically be certain of the accuracy of the result within one per cent.; that is to say, if the slider ought to theoretically stand at 100 on the scale when the required balance is obtained, then if it were one division out, the depression of the key should produce a slight but perceptible movement of the galvanometer needle.

The facility of making the test may be considerably increased by the following arrangement: Use a *sensitive* galvanometer of a resistance not exceeding about 10 ohms; then when all the connections are made, and the battery joined on, a strong deflection will be obtained. Now bring the needle as near back to zero as possible by bringing in its proximity a strong permanent magnet; this done, adjust the slider, S, till on depressing it no movement in the needle is observed. It will be found that with this arrangement a considerable movement of the needle will be produced on depressing the slider, S, when the exact adjustment of the latter is but very little out.

Another arrangement which may be very conveniently adopted is to employ a *sensitive* galvanometer of low resistance, wound with two wires. One of these wires would be joined in circuit with the bridge, the other would be connected in circuit with a small battery and a set of resistance coils, the connections being so made that the currents through the two coils oppose one another. When the deflection due to the battery under test is obtained, the second battery and resistance coils are connected up, and then this battery is adjusted until the needle is brought to zero as nearly as possible. The test is then made, as in the case where a permanent magnet is used.

If the test is made with a very sensitive galvanometer, of low resistance, either with a permanent magnet, or with

* We give this article in reply to one of our correspondents (see page 281).

a double wire and an extra battery, it is best to make *d* as nearly equal to the resistance of the battery as possible (it should not be made less), as in this case, since the slider, s, will have to be set near the centre of the scale, a greater range of adjustment is given to it, for five divisions near the centre portion of the scale (500 division mark) is equivalent to only one division near the 100 division mark. It is true the arrangement is not quite so sensitive as when the slider has to be set towards the end of the scale; but still, if we can employ a very sensitive galvanometer, this small loss of sensitiveness is more than compensated for by the increased range which can be obtained on the scale.

C. VERNON BOYS' METERS.

At the meeting of the British Association at Southampton, Mr. Boys showed and described a series of models and instruments of his invention for the integration of curves and electrical and mechanical forces. The first instrument described was a curve integrator, which is an exact mechanical equivalent of the formula of integration. It is chiefly of theoretical interest, since it clearly illustrates several of the well-known mathematical rules, and since it originates the logarithmic curve. The development of this instrument gives the disc cylinder integrator (fig. 1). A disc, mounted in a swivel frame, rests against a cylinder.

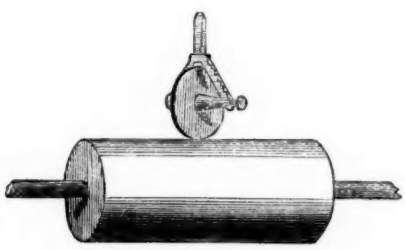


Fig. 1.

If the plane of the disc is parallel to the axis of the cylinder, longitudinal motion of the latter is unaccompanied by rotation, but if the swivel frame is turned, the disc will describe a screw line on the cylinder, which therefore must turn. The rate of turning is equal to the rate of longitudinal motion multiplied by the tangent of the inclination of the disc. This process of mechanical integration is the most perfect in existence, for it depends upon pure

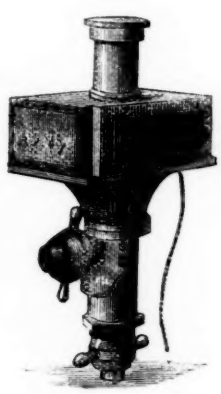


Fig. 2.

rolling only, and the force necessary to incline the disc, and the moment of inertia of the disc and swivel frame, are each infinitesimal; thus it is specially and indeed the only one applicable to the case of delicate or rapidly varying forces.

The most important application of this integrator is the engine-power meter, an instrument which will find and record on a dial the amount of work done by steam or other fluid under pressure at either or both ends of the cylinder of an engine (fig. 2). The pressure or the difference of pressure determines the displacement of a piston-rod controlled by a spring, as in a Richard's indicator. A pin on the piston-rod entering a radial slot on a swivel frame inclines the latter, so that the tangent of the inclination is proportional to the steam-pressure or difference of pressure. A disc carried by the swivel frame rests against a cylinder which is moved longitudinally by a reducing lever or by pinion gearing connected with the piston-rod of the engine. The pressure multiplied by the rate of motion is the rate of doing work. These are represented by the inclination of the disc and the longitudinal movement of the integrating cylinder. The rate of rotation of the cylinder is, therefore, proportional to the rate of doing work, and the number of revolutions in any time gives the work done in that time.

The electric-energy meter is another application of the disc cylinder integrator. A cylinder is caused to reciprocate longitudinally by a mangle motion, driven by clockwork. Mounted in a common swivel frame on either side of it is a disc, against each of which the cylinder bears alternately. So long as the discs are horizontal the cylinder does not rotate, but if they are inclined it rotates always in one direction, for the cylinder bears against one in its forward and against the other in its return journey. The rate of revolution is proportional to the tangent of the inclination. The swivel axis carries a transverse beam, from one end of which hangs a weight, and from the other a solenoid made of a great length of fine wire, which is wound in opposite directions at the two ends. This solenoid hangs in the annular space between two solenoids of thick wire. The swivel axis also carries a pendulum weight to resist deflecting forces. The main current is made to pass in the same direction through the fixed solenoids, and a shunt current through the moveable solenoid which then is dragged down with a force proportional to the product of the currents, and therefore to the energy of the current. This causes the beam to be inclined, so that the tangent of the inclination, and therefore the rate at which the cylinder turns, is proportional to the energy of the current; the number of turns therefore is a measure of the total work done.

At one time Mr. Boys thought of applying the disc cylinder integrator to find the total quantity of electricity that has passed in a conductor; but various difficulties and the expense of such an instrument made it unsuitable for an electric meter such as would be fit to take the place of the gas meter. He therefore invented what he has called the "vibrating electric meter," which depends on a totally distinct but valuable principle. The rate of a clock or a watch is proportional to the square root of the strength of gravity or of the hair spring; the force of an electro-magnet on an armature is proportional to the square of the circulating current; if, therefore, gravity or the hair spring is replaced by electro-magnetic force, the clock or watch will cease to measure time, but will go with a *rate* directly proportional to the current strength, the "time" measured is, therefore, the integral of the current or the quantity of electricity passed.

This principle has been applied in a great variety of ways, a description of which would occupy too much space; suffice it to say that the instrument has become more simple as it has become more perfect, so that at the present time the inventor thinks he cannot be far from the ultimate form. In one of the late instruments, there is a vertical vibrating axis, carrying an armature which oscillates between the poles of a horizontal electro-magnet excited by the current. The moment of inertia is increased by weights. As in a clock, an escapement of some kind is necessary to maintain the oscillations, so here, either a mechanical or electrical impulse must be given to the balance when necessary. With this object, a second electro-magnet is fixed and connected, so that when the amplitude has died down to a particular limit, a portion of the current in the first is for a moment shunted through it, and so gives an impulse which restores the amplitude to its former amount. There is an arrangement which, as soon as the current ceases, causes the vibrating axis to turn to one side, so as to be ready to start again. The meter may be used either to take the whole current or as a shunt. The main current that passes through it is never broken, so that the meter itself can in no way be a source of danger. The contact on which the meter depends is only occasionally made, and then in a decided manner and

with force, so that it is less likely to give trouble than one which is continuously on the point of being made. The quantity of electricity can be read from a dial without trouble.

All the instruments described so far have been integrators, that is, instruments to determine an amount *during* a time. There is another class of instruments devised by Mr. Boys, of which he showed one only. Its object is to divide the speed of one motion by the speed of another, and continuously record the quotient. If these speeds are the speeds of record of two integrators which are finding the

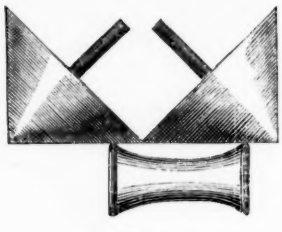


Fig. 3.

work put in and the work sent out of any combination of mechanism, such quotient measures continuously the efficiency of the combination, or generally, if the speeds represent any two things the divider will show continuously the value of one in terms of the other. Two soft iron cones are mounted base to base, so that the lowest line in each is horizontal and continuous (fig. 3). These are made to revolve, and a magnetised steel reel hangs on below and travels about, always showing by its position the ratio of the speeds of the cones. It may carry a recording pencil, if desired.

ELECTRIC LIGHTING AT HULL.

On Thursday, September 28th, the electric lighting of some of the streets of the old town of Hull was officially inspected by the Mayor of Hull and the Lighting Committee.

The party assembled in the Town Hall at 7 p.m., and witnessed the starting of the lights in the various rooms and passages. Six arc lights of about 1,000 candle-power each, supplied from an S D_8 machine, and about a hundred Swan incandescence lights of 16 candle-power each, worked by two S D_2 machines, are employed for lighting up the building.

Later on the lights in the streets were started, comprising four 3,000-candle-power lights, each worked by a D_7 machine, and twenty-two 300-candle-power lights, worked by a W_1 D_7 machine in two circuits. The four strong lights are suspended from Williams' tubular poles, about 50 ft. above the roadway, and are enclosed in lanterns similar to those in use at the Royal Albert Dock. They are placed one on the pier, the second on the Market Place, the third behind Trinity Church, and the fourth in Whitefriars Gate, near the bridge over the docks.

The smaller lights are on lamp-posts, exactly similar to those used last year in the City of London, and are distributed over the principal thoroughfares at about 100 yards distance from each other.

The station is situated in the yard of Messrs. King & Co., South Church Side, and contains two 12-horse-power compound semi-portable engines supplied by Messrs. Wallis and Stevens, of Basingstoke, each of which is capable of working the street light alone. Suitable arrangements are also provided for measuring the currents, and for interchanging the machines.

The Town Hall is about 1,000 yards distant from the station, and the two circuits of the smaller lights measure 1,930 and 1,700 yards respectively.

The lighting was witnessed by a large crowd of people, who expressed themselves as very well satisfied with the result, and it will be continued for the next twelve months.

The contract has been carried out by Messrs. Siemens Bros. & Co., the work being done under the superintendence of Mr. F. W. W. Melhuish.

ELECTRIC LIGHTING AT THE ROYAL ALBERT DOCK.

As may be remembered, four stations have been erected in the dock, each containing a 20-horse-power condensing engine, supplied by Messrs. Marshall & Co., and a number of electrical machines. Some of these work the powerful arc lights suspended from tall latticed iron posts, and others, giving alternate currents, are connected with two main leading wires running along all the sheds on the north-side of the dock. At each shed a commutator is provided, so that the current can be turned into the shed or the shed may be cut out.

Specially constructed suspenders are suitably distributed over the interior, the front, and the back of the shed, to which the lanterns containing the electric lamps can be attached; provision is also made for connecting ships lying alongside the quay, by means of movable leading wires to the circuit, so that electric lights can be placed in the hatchways, and below, for facilitating loading and unloading during night-time.

As this mode of working has given universal satisfaction on the north-side of the docks, Messrs. Siemens have now received a further order from the dock company to fit up the sheds on the south-side in a similar manner, and the work is being pushed on with all speed.

METHODS OF EXCITATION AND OF AUTOMATIC CONTROL OF DYNAMO-ELECTRIC MACHINES.

The method of excitation for the electro-magnets of the dynamo-electric machines ordinarily adopted is that for which we are apparently indebted to Hjorth. It is too well known to require a description, and we generally give it the name of surexcitation (mutual accumulation). The principle is applied, moreover, to all methods in which the electro-magnets are excited by the armature of the same machine. It is represented diagrammatically in fig. 1, and may be con-

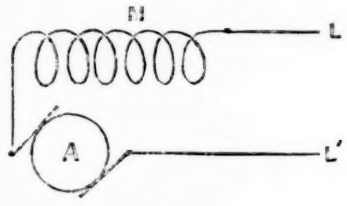


Fig. 1.

sidered in this investigation as the *ordinary* method; the electro-magnets, M, are in the same circuit as the armature, A. L, L^1, represent the terminals of the machine.

There is a prior method of exciting the magnets of the

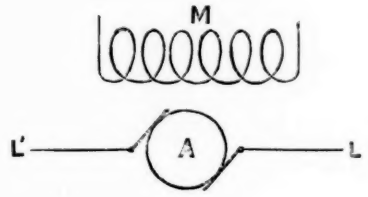


Fig. 2.

machines, which is due to Sinsteden (*Pogg. Ann.*, 1851, Vol. lxxxiv., p. 186). It consists of producing entirely, by an auxiliary machine, the current which circulates in the coils of the magnet; this is represented in fig. 2, but the auxiliary

machine is not shown in the drawing. This arrangement is still frequently employed, the regulation in the principal circuit or in the armature being brought about by the variation of the force of the exciting current coming from the auxiliary machine. Such a system necessitates the employment of a regulator to introduce resistances into the circuit of the auxiliary machine, or to remove them; it requires also a second machine, and constitutes a costly and troublesome arrangement in consequence of the complication of the apparatus.

Quite recently, M. Marcel Deprez has made known a combination of these two methods in a system remarkable for its simplicity, the facility of understanding it, and its numerous applications. M. Deprez has not only demonstrated that the theory of his combination is applicable to practice, but he has shown numerous and important applications of it.

This system consists (fig. 3) of coiling side by side, upon the inductors of the electro-magnet, two wires of equal

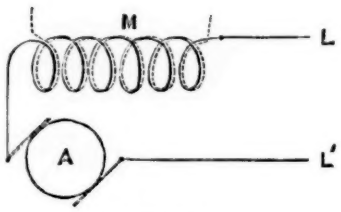


Fig. 3.

diameter; one of the circuits is traversed by the current of an auxiliary machine, the other by the current which the armature of the machine itself produces in its rotatory motion. The first circuit is employed to maintain an "initial field," the second develops in the ordinary fashion the full power of the inductors. In order that the electromotive force may remain constant, it suffices to attain a certain speed; to maintain the intensity of the currents the inductors are arranged in a circuit derived from the principal circuit, and the same speed gives the desired result: however, in each case, the resistance of the exterior circuit may be varied.

Thus, without any auxiliary apparatus, excepting an excitor, beside the ordinary dynamo machine, the system of M. Deprez presents a perfect mode of regulation, which, by the simple operation of a commutator, can maintain constant either the electromotive force or the intensity of the current, whatever the variation which is produced in the resistance of the internal circuit.

In December, 1881, this system was completely described in the columns of *La Lumière Electrique*; in the month of March of the same year I had applied for a patent at the United States Patent Office, which was granted in June, for an arrangement of the inductors of a dynamo machine allowing of obtaining the same results without any auxiliary excitation. It is scarcely necessary to add that my experiments had been made long before.

Before coming to the description of this system I would observe that Wheatstone, in an anterior memoir (1867), had proved the advantages of mounting the inductors in derivation, an arrangement which has only been recognised quite lately. Mr. Edison, without this manner of arranging his machines, would probably be still in the same position for the excitation of a low resistance machine as the greater part of the constructors of electrotyping machines who have not yet adopted this kind of mounting. This is, in fact, the only efficacious manner of mounting these machines. It is represented in fig. 4. From an historical point of view we can see that the great inductors now employed in the best constructed machines are evidently only an exaggerated imitation of the forms of machines designed and constructed by Wheatstone, and I can also affirm that, for him, this construction was not a matter of chance. Indeed, a number of ancient machines, witnesses of the most ingenious conceptions, are now presented as modern inventions. We ought even to include in this category the idea of the initial field, if we accept the description of Hjorth's machine (1854). We find there all the elements of the initial field, although the description is not sufficiently practical. In the specification which I presented to the United States Patent Office in March, 1880, but which I subsequently withdrew, I thought to obtain an initial field by introducing, amongst the other inductors of a machine, electro-magnets having portions of their cores of steel; but the great dimensions required to make sure of practical results and the inferiority of the steel which one could procure in America for this purpose, soon made me abandon this idea in favour of a combined system of electro-magnetic inductors.

I arranged this combination in the following manner: We chose, by preference, a dynamo machine bearing several electro-magnets to form each of the magnetic poles of the inductors. (Or, if it is a machine in which there is more than one pair of poles, the distribution will be made between the various series of magnets, as will be easily understood.)

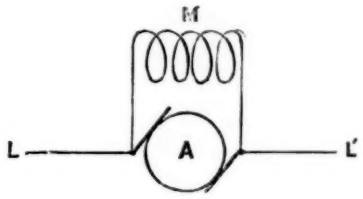


Fig. 4.

Some of these electro-magnets are included in a derivation between the poles of the armature of the dynamo machine, and the others are disposed in the principal circuit. The proportion of the distribution will vary according to the object and according to the electromotive force of the machine.

Fig. 5 is a diagram of the machine thus arranged. Fig. 6 shows a Bürgin machine so arranged.

By accepting the demonstration given by M. Marcel Deprez (*La Lumière Electrique*, Vol. VI., p. 309) as applying to this case, although, in consequence of the introduction of another variable, the integration can only be made by a fraction, we see that we have an initial field formed by the

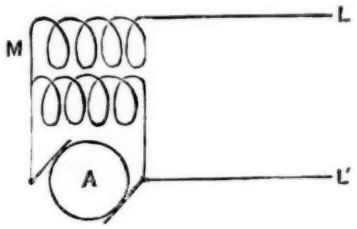


Fig. 5.

magnets of the derived circuit, and it is easy to find the speed for which the difference of potential in the principal circuit ought to remain constant, notwithstanding variations of resistance. But the variation of speed necessary to establish this condition will alter the initial field, and, consequently, will modify considerably the analytical solution of the problem.

However, in practice, a system of conical pulleys offers a simple solution to the question of the determination of the speed. By referring to the diagram employed by M. Marcel Deprez, and remembering that in this case diminution of speed signifies decrease in the quantity of the current which produces the initial field, as well as in the potential corresponding to this quantity of current, we can easily understand that it is necessary to have some other series of determinations of the electromotive force corresponding to the varying intensity of currents, and this is the only practical difficulty which must be first surmounted by the manufacturer of a machine for finding the suitable speed.

If the inductors are arranged in such a way as to comprise in one circuit all those which correspond to the north pole of the machine, and in another circuit all those which give the south polarity, a curious state of things is brought about.

We know that if one pole only of the inductors of a dynamo machine be excited there is practically no current, and that if we excite the poles unequally we do not obtain all the power of current which we should have by an equal excitation of the two poles; it is easy to see the reason. Let us suppose now that we arrange our derived system of inductors to have a certain magnetic field produced by a certain quantity of current and a certain number of turns of wire in the inductors; if the magnetic field corresponding to the other pole and to the other circuit is not maintained, or nearly so, at the same intensity, the current furnished by the machine will have practically disappeared. That is to say, that one can construct on this principle a machine which will give a current only when the external circuit is in a normal condition; it is unnecessary to insist upon the enormous advantages which one can derive in certain circumstances from this possibility without the help of any kind of auxiliary.

derivation upon an ordinary dynamo, one introduces into the principal circuit a magneto-electric machine, or a battery producing a constant electromotive force equal to that which should exist between the auxiliary and the outgoing and return wires of the principal circuit. The speed of the dynamo machine ought to be such that the electromotive force produced may be proportionate to the current which circulates in the inductors, or, in other words, as the field in which the armature moves, or proportional to the magnetising current. When a dynamo mounted in derivation is employed Professor Perry prefers to place the magneto machine in a part of the circuit completely outside of the machine, that is to say, in the principal circuit, in such a manner that the current passing through is that which goes to the supply cable.

These arrangements are suitable when the lamps are arranged in derivation; when the lamps are in series a dynamo machine is employed in derivation, and a magneto-electric machine. If we call M the portion derived from the dynamo, and A the circuit from the armature, the two ends of A and of M are similar, and may be called the terminals of the machine. If these terminals are connected to the two ends of a circuit containing a series of lamps, and a

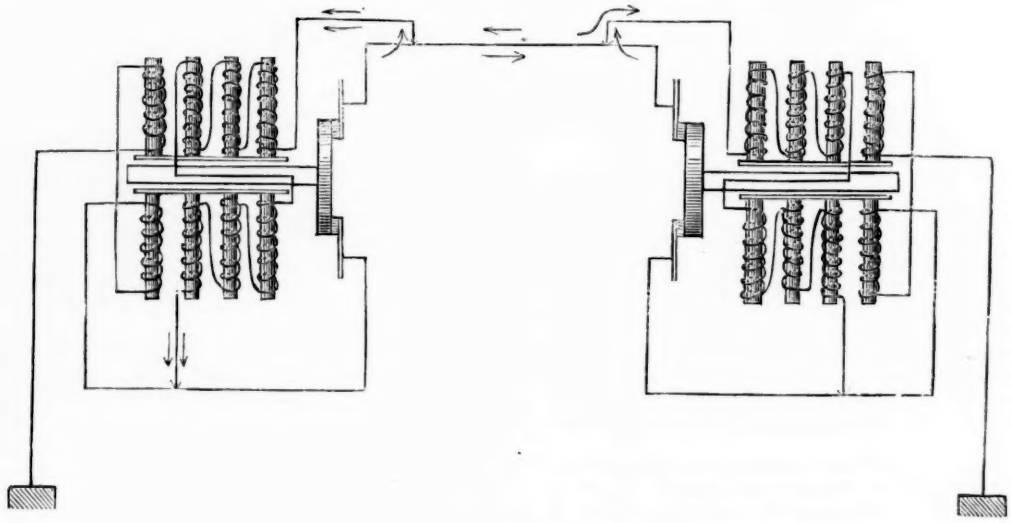


Fig. 6.

Besides the advantages either for lamps, or for motive engines actuated by a machine which is arranged according to the combined principles of derivation and of a primary inductive circuit, each lamp or motor is absolutely independent of its neighbour in the same circuit, so much so that one can extinguish the one or stop the other, light up again and put in motion without any influence upon the others. There is yet another benefit. Whoever has manipulated the large dynamo machines set up according to the ordinary plan must have experienced a continual anxiety, when they were moved by an engine having very little surplus power, as to what would happen if the circuits were suddenly and completely severed. A very serious accident happened to me under these conditions, and the result was the almost complete destruction of the motive engine, for the regulator could not follow the lightning rapidity of the electric current. In the case of the combined system the charge is never completely suppressed, and the motor, slightly weakened, soon comes to a standstill. The same cause of danger is encountered with the simple system of derivation employed alone when the external circuit is short-circuited, or when a lamp ceases to act.

A method for the distribution of electrical energy has been recently patented by Professor John Perry. It consists of combining with the dynamo machine one or several magneto-electric machines or other sources capable of producing in a circuit a constant electromotive force independent of all the other electromotive forces which are found in the circuit. When the principal wires are arranged in magneto-electric machine is introduced from the side A or from the side M, or even if we have one magneto-electric machine in A and another in M, we can impart to the machine a speed capable of making it produce a constant current of electricity through the external circuit, whatever variations the resistance may give.

The constant current is that which the magneto-electric machine or machines would produce in a circuit of which the total resistance is equal to the resistance of A.

There, are thus, three methods of absolute regulation which are offered to electricians—that of M. Marcel Deprez and that of Professor Perry, each requiring an auxiliary machine or the equivalent; then that which I have just explained myself here, and which requires only one machine to obtain practically the same result.

By reviewing these inventions I put formally aside all desire of claiming a priority, even if it is due to me; for I am persuaded that the process which is most practicable wil procure at the present day the best recompense to its inventors; besides, each of those which have been described possesses its advantages.

I reserve for a future publication a more profound study of this question.—*Paget Higgs, in La Lumière Electrique.*

The London and Globe Telephone Company.—We hear that the licences asked for have at last been granted to this company by the Postmaster-General.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE INTERNAL RESISTANCE OF BATTERIES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Will you, or will some of your correspondents, be so kind as to inform me, through the columns of the Review, how I can accurately measure the internal resistance of a cell (say a Daniell) by Mance's method on the slide-wire Wheatstone bridge? My bridge has a scale-reading of one metre, and is made like that described on page 135 of Kempe's "Handbook of Electrical Testing," new edition. I would be glad if you would give a diagram or figure of all the necessary connections, and work out an example. Should Mance's method not be a desirable process for the slide-wire bridge, please give one that is desirable, and oblige,

Yours, &c.,
SAMUEL PURNELL.

San Francisco, California, U.S.A.,
September 11th, 1882.

[An answer to our correspondent will be found on page 276.—EDS. ELEC. REV.]

THE RESISTANCE OF CARBON AND LIGHTNING PROTECTORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The article in your journal of August 19th, which contains some extracts from a paper of mine published twelve years ago, has elicited two communications of practical interest from Mr. Haynes, and an angry growl from another correspondent, who accuses me of "reinventing and rediscovering old things," and suggests that "the world must be coming to an end" because what he evidently would have preferred to be considered dead has been proved to be still alive.

Resurrections are not always convenient, and I suspect the real offence in the eyes of my critic consists not so much in my having invented the "Lightning Bridge" as in the demonstration by Mr. Haynes of its efficiency as a lightning protector. My adverse critic, however, has omitted one thing in his communication, and this omission happens to be the only thing which could possibly have given any value to his criticism: the letter is published without his name, and the only reply I have to make is "denunciation is always easier than suggestion as criticism is easier than creation."

Mr. Haynes informs us that he has 110 instruments protected by lightning bridges, that 73 of these bridges have been in use for fifteen years, and 33 have been doing duty for twelve years. He tells us, further, that not a single case has occurred during the whole of this time of an instrument so protected being damaged by lightning. Can any practical engineer who has had the charge of telegraphs say as much as this of any other form of lightning protector?

I do not know whether Mr. Haynes has had any experience of plate protectors, which were so much lauded by Mr. Preece in a paper read before the British Association meeting of 1879, and to which he referred as an example of "the survival of the fittest;" but there must be amongst your numerous readers many who have had experience of this form of protector, and it would be interesting if they would inform us of their behaviour in practice, whether cases have occurred of coils being fused when so protected, and whether a lightning discharge does not very frequently short-circuit the instruments.

Mr. Haynes in his second communication states that many cases have occurred where the resistance of the bridges has been so reduced by the effect of a lightning discharge as to practically short-circuit the instruments, their efficiency, however, being immediately restored by "a slight tap" on the lightning bridge; and he asks whether a similar effect has been observed in powdered carbon telephone transmitters.

The currents employed with telephones are of low potential, and the effect noticed by Mr. Haynes is only produced by the passage of currents of very high tensions. If he refers to the first page of your article of August 19th he will find what I believe to be a correct explanation of the effect noticed.

Whilst on this subject I may say a few words on the action of the carbon transmitter of a telephone. I see in a paper read before this year's meeting of the British Association by Mr. Preece the action is attributed to the reduction of the resistance of the carbon at the points of contact by the passage of the electric current developing heat.

Some experiments which I have tried do not seem to me to support this view. Carbon absorbs moisture certainly, when in the form of powder, and probably to a more or less extent in all its forms. Polarisation of this moisture occurs when the circuit is closed, and this effect is very apparent in the case of powdered carbon which has been kept in a damp room.

I may mention that the temporary short-circuiting observed by Mr. Haynes in my lightning bridges after lightning discharges will be found, I believe, to be almost entirely obviated in the later construction of these protectors. The body of the protector in the newer form is a chamber of metal, which is connected directly with the earth. Three pointed conductors approach one another in the centre and are surrounded with carbon powder; one of these points is connected to the frame and the other two are insulated, and are connected to the two ends of the insulated wire forming the coils of the instrument. In this construction, therefore, there are three courses open for the lightning discharge: the lightning can effect its discharge by leaping a short space of air, without passing through the powder at all, or it may pass through the powder directly to earth, or across the powder through the insulated conductors. In practice, I believe, it will be found that the greater part or the whole of a heavy lightning discharge will take place outside the protector, whilst the secondary discharge arising from the line wire passing from the magnetised to its normal condition, and which I believe I have demonstrated to be the current which fuses the coils, will pass from one of the insulated conductors through the carbon powder to earth direct.

My bridges were introduced in 1866, and at the time my paper was read at the meeting of the British Association in 1870 upwards of 1,000 of my bridges were doing duty, and not a single case had occurred of a coil being damaged when so protected. Cases, however, occurred in which lightning discharges destroyed the bridges altogether, burning up the powder and fusing the conductors; but the percentage of these cases compared with the number at work was very small. After the reading of my paper the Postal Telegraph Department adopted my bridges for protecting the local circuits, and, speaking from memory, some 7,000 or 8,000 were fitted. A violent lightning storm occurred in the metropolis some time after this, discharges of lightning taking place almost continuously, melting the gas pipes and setting fire to the gas in more than one office. I was informed by the postmaster of one of these offices that there was a noise like the continuous cracking of whips during the time the storm was raging.

The effect of this certainly abnormal storm was to destroy some of the bridges, and on this, which I cannot but consider insufficient ground, the Postal Telegraph Department discontinued using them.

S. ALFRED VARLEY.

2, Hamilton Road, Highbury Park, N.

AKESTER'S ARC LAMP.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In my preliminary report upon Akester's arc lamp, the figure of performance should be 1,500 candles per electrical horse-power, not 500. The exact figures for an elevation of 30° were: for red light, 1,343 candles; for green light, 1,838. The mean of these values is 1,560·5.

I am, yours faithfully,
SILVANUS P. THOMPSON.

October 3rd, 1882.

TELEPHONIC COMMUNICATION WITH DIVERS.

To the Editors of The Electrical Review.

Sirs,—In reference to a notice which appears in your journal under the above heading, I should like to say, if you consider the matter to be of sufficient interest, that, shortly after Prof. Graham Bell came over to this country bringing his now well-known telephone, I had the pleasure of carrying out some experiments, in conjunction with Prof. Bell, in consequence of my suggesting the application of the telephone to diving operations.

The telephones were constructed, under my superintendence, at the works of Messrs. Siebe & Gorman, and the experiments were made in the diving tank of this well-known firm.

These experiments were referred to by Prof. Bell during his lecture at the Society of Arts, Adelphi, and the fitted helmet was exhibited by him to the audience.

I am, Gentlemen,
Your obedient servant,
S. ALFRED VARLEY.

2, Hamilton Road, Highbury Park, N.,
October 3rd, 1882.

THE LANE-FOX INCANDESCENT LAMP.

To the Editors of The Electrical Review.

Sirs,—At the general meeting of shareholders of the Devon and Cornwall (Brush) Electric Light and Power Company, as reported in your journal of the 9th ultimo, a shareholder inquired of the chairman why the directors issued the prospectus stating that they had purchased the *exclusive* right to use and sell in Devon and Cornwall the "Lane-Fox" incandescent lamp, seeing that he had ascertained that a prior licence was registered at the Patent Office in favour of the British Electric Light Company.

The Chairman in his reply said, as reported by you, *That unless the directors really supposed that they had such exclusive right they would not have issued such a statement. The Company did not know of anything to the effect that they had not the exclusive right. If a fraud had been committed upon them by the sellers they had their remedy.*"

The shareholder (Mr. Tyler) said he thought the answer given extremely unsatisfactory; and so do I. Whether a fraud has been committed or not, there can be no doubt that the directors must have been, to say the least, extremely negligent in not ascertaining that so important a part of their prospectus was true or the contrary.

In my letter, which appeared in your number of the 16th ult., I supplied the information which the Chairman did not—that the prior full licence to the British Electric Light Company is still in force throughout the United Kingdom.

It is dated the 27th July, 1881, and can be seen by payment of a shilling at the Commissioners of Patents Office, Southampton Buildings, Chancery Lane, on applying for the records relating to the Lane-Fox Patents, Nos. 3,988, 4,043, and 4,626, of 1878. It stands at the head of the list of agreements relating to the patents, and is followed by an assignment from Mr. Lane-Fox, of a later date, to the Anglo-American Brush Corporation, in which the British Electric Light Company's previous general licence is specially referred to and excepted from the operation of the assignment.

Since I wrote the letter in question, I have referred to the Devon and Cornwall Company's prospectus, and I find it there stated that the directors have acquired the *sole right* to use and sell in the Counties of Devon and Cornwall all the Brush patent dynamo machines, lamps, &c., and the Lane-Fox incandescent lamp, in consideration of £19,750, out of a nominal capital of £100,000. But I find that this is a mere fragment of the operations of this character.

The directors of a single company might be ignorant, through carelessness, that they were inviting subscriptions upon a false statement and paying a large amount of the shareholders' money away in connection with it; but the case becomes yet more serious when it is found that this procedure has been systematic; for I find that nearly the same words (untruly alleging the acquirement of these exclusive rights) were embodied in the prospectuses of the following companies:—

The Great Western Electric Light Company, Limited; The South Eastern (Brush) Electric Light and Power Company, Limited; The Brush Midland Electric Light and Power Company, Limited; The Birmingham and Warwickshire (Brush) Electric Light and Power Company, Limited; The Staffordshire and Worcestershire Electric Light and Power Company, Limited; The Yorkshire Brush Electric Light and Power Company, Limited; The Brush Electric Light Company of Ireland; The Brush Electric Light and Power Company of Scotland.

Perhaps this list might be added to. Some of these exclusive rights profess to be sold by the Anglo-American Brush Corporation; others by the Hammond Electric Light and Power Supply Company, Limited, to whom the former company sold some licences, as can be seen at the Patent Office.

Some of the Directors of the Brush Company went on the Boards of the affiliated companies. I also find, which appears to me remarkable, that the solicitors to the Hammond Company are also solicitors to four of the companies enumerated above. I remember many cases in which shareholders have recovered from directors and vendors the money which they had been induced to invest by false statements held out in prospectuses, and I am surprised that the chairman of the Devon and Cornwall (Brush) Electric Light and Power Company did not frankly agree to the request of the shareholder who asked for a committee to inquire into the truth of the grave allegations made by him on this subject.

Yours faithfully,
CHARLES T. BRIGHT.

31, Golden Square, London, W.,
October 3rd, 1882.

G. W.—Your suggestions shall have due consideration at our hands.—[Eds. Elec. Rev.]

NOTES.

The American Association for the Advancement of Science.—On the third day of meeting Prof. Putman, the permanent secretary, announced that 227 papers had been entered. Dr. J. W. Dawson, Montreal; Prof. F. W. Clark, Cincinnati; Dr. Edward S. Dana, New Haven; Prof. H. W. Martin, Baltimore; Prof. C. A. White, Washington, were appointed a committee to confer with the British Association on the annual records of science. The following committee was appointed to confer with committees from foreign associations for the advancement of science, with reference to an international convention of scientific associations, viz.:—Dr. T. Sterry Hunt, Montreal; Prof. Alex. Agassiz, Cambridge, Mass.; Prof. Simon, Newcomb, Washington. Immediately on the adjournment of General Session, Section B met in the William Molson Hall for the purpose of hearing an address by Prof. Alexander Graham Bell, upon "The Electrical Experiments to determine the location of the bullet in the body of the late President Garfield, and upon a successful form of induction balance for the detection of metallic masses embedded in the human body."

Prof. Bell said that the subjects of his lecture recalled a time of intense excitement among the American people. In the dread of the barbarous method of knife and probe in discovering the hidden bullet, he and other scientific men in the States cast about for some less painful means. The telephone naturally suggested itself as a means of doing this in connection with the ordinary induction apparatus invented by Prof. Hughes, of which the principle is the neutralising of the action of one set of coils by the reversed action of the second. Prof. Roland, by the action of the galvanometer, modified this induction apparatus, and this was afterwards improved by other inventive scientists. The lecturer himself, when the news of the assassination flashed through America, had just invented an induction apparatus, consisting of two flat coils of wire, superimposed on one another. Prof. Newcomb thought the presence of the bullet might be indicated by the retardation of a magnetic needle caused by the lead. The lecturer offered to make any experiments necessary, and Prof. Newcomb requested that he would discover whether the presence of a leaden bullet would deflect a magnet needle suspended over it. He applied the principle of the induction balance, and was astonished at the instant effect upon the needle, the bullet being placed about an inch from it. In the ordinary induction balance the influence of the bullet was not manifested at any distance, and the task was now come to construct

a balance which could overcome this difficulty. The best theoretical arrangement of coils for an exploring machine was learned from different sciences. The coils, when made and tried, were, however, no better than the first, being extremely sensitive to a piece of lead within the helix, but with a hearing distance of only about an inch and a half. After trying all sizes of coils from one of the size of the bullet explored for, and using battery-power varying from one to twenty Bunsen cells, the hearing distance of the bullet remained about the same. It was then determined to proceed empirically to discover the necessary coil. An instrument was made in which a brass ring was used instead of a leaden bullet, and, under different conditions, the hearing distance increased with the diameter of the primary, but the maximum effect was gained when a secondary coil was placed outside the primary. This led to the idea that the primary should be larger than the secondary, and, acting on this idea, a new instrument was constructed, the hearing distance of which was five centimetres. On the 22nd July, 1881, an experiment was made, by the request of Dr. Bliss, on the person of Lieut. Simpson, who had carried a bullet in his back for a number of years. A sonorous spot was found. The results were communicated to the President's medical attendants, and they decided that an experiment should be made on the person of the President on July 26th, 1881. Prof. Knowland suggested before this, however, the addition of a condenser to the circuit, and by this means a distinct whistle was heard when the apparatus was placed near a piece of lead. The results obtained at the experiment were as follow:—The telephone gave a peculiar spluttering sound, which could not be lessened by any arrangement of the coils. Passing the apparatus over the lower part of the right side of the President's abdomen a sudden increase of sound was heard, but a repetition of the operation failed to verify this. Owing to the faulty adjustment of the condenser the experiment was not a success. The condenser was improved and the apparatus tried successfully upon several old soldiers who were wounded in the civil war. Flattened coils were afterwards used, and by this means a hearing distance of 12 centimetres, or five inches, was obtained. The two coils were placed in a wooden handle, and a clearly-marked sonorous spot was easily discovered on the body of a wounded soldier. With this apparatus a second experiment was made on the body of the President. The instrument was now so sensitive that a pulsation was secured at two elevations upon passing it over the body of the President. An area of sound was discovered, and it led to the idea that the bullet was within this area, which was afterwards found to be incorrect. This area of sound was produced by a steel wire mattress under the President's bed, a fact which had been overlooked by the President's physicians. The apparatus was afterwards improved by embedding the two ends in paraffine as nearly as possible in a position of silence, the slight residuum being overcome by the smaller coil connected with the larger one and adjusted by a micrometer screw. With this a successful experiment was performed on the body of Colonel Clayton, who had suffered for several years from the presence of an Enfield rifle bullet. The apparatus was subsequently modified in form for purposes of convenience, and now the exact position of a bullet in any part of the human body could be accurately determined. The results may be regarded as giving promise of still greater possibilities in the future. The work in this direction, the writer concluded, had been merely a matter of love, and he could not have had a higher inducement than to alleviate human suffering.

At the conclusion of Prof. Bell's paper, an unanimous vote of thanks was passed.

The vice-president, Mr. T. C. Mendenhall, of Columbus, O., afterwards communicated a paper on the reduction of the electrical resistance of the carbon button by the passage of an electric current, in which he gave a description of experiments for the determination of this resistance, showing that the resistance is lowered by the passage of a current of electricity.

Among the other papers read in this Section were two by A. E. Dolbear, "On the Construction of Magnets," and "On Electrical Conduction *versus* Induction."

In the Mathematical and Astronomical Section Professor Pliney Earle Chase, of Howerford College, Pa., read a paper "On the Conservation of Solar Energy."

All forms of solar energy, he said, are due to solar radiations. The maintenance of their energy, therefore, depends on the maintenance of the radiations. Every solar particle is continually solicited towards different nodal centres of gravity. Hence arrive cyclical oscillations, representing the results of equal actions and reactions, in which the particles alternately recede and approach the several centres of gravity. The nodal action of centres of gravity is accompanied by an unstable equilibrium of the sun's photosphere, in consequence of the photodynamic equality of luminous and gravitating oscillations which tend to drive all the particles towards the limits between aggregations and dissociation. Berthelot's investigations of explosions of gaseous compounds by detonating agents have indicated the existence of explosive waves, which are quite distinct from waves of sound, and have shown that compounds and explosive mixtures generally become non-sensitive to shocks as they near the temperature at which they begin to decompose or combine. Hence a meteor, or even a single molecule, which has acquired a sufficient velocity of subsidence in its downward fall, may explode a gaseous compound which is in, or near its nascent state, and the explosion may react upon the falling mass or molecule, so as to leave it in a state of unstable equilibrium which is ready for explosion by the next like subsidence. The particles which are repelled to Laplace's limit, as Siemens has shown by the centrifugal force of solar rotation, yield a mechanical equivalent of 152,000,000 T for every pound of matter that subsides to the poles. The spiral character of the subsidence gives rise to Amperian currents, which account for Maxwell's identification of luminous and electro-magnetic waves.

On the 28th August, after a brief respite, the Congress resumed deliberations. After electing a number of new members, paying a tribute to the late Charles Darwin, disposing of Committee Reports and Requests and other formal business, the various sections met and discussed the numerous papers submitted to them. The following extracts are from those papers most likely to interest our readers:—

Professor C. S. Hastings, the Secretary of Section B., read a paper on certain complex flame spectra of sodium. Mr. Hastings described methods by which the well-known double sodium line shown by sodium vapour in a Bunsen burner may be made to appear as constituted by any number of lines from two to eight. He also called attention to a possible explanation of certain close double lines in the solar spectrum.

Mr. Brown Ayres, of the University of Louisiana, New Orleans, read a paper on some phenomena of diffraction due to the shape of the source of light.

Light from a source of different dimensions in directions at right angles to each other is allowed to pass through a square mesh wire gauze. The phenomena observed on a screen placed beyond the gauze is peculiar. Shadows parallel to the longer dimensions of the source of light are observed with little or no shadows at right angles to them. An imperfect image of the wires of both sets is seen in rotating the source of light through an angle of 45 degrees. A blurred appearance is sometimes all that there is of this phenomena. A diffraction phenomenon of great beauty is produced by passing sunlight through a cylindrical lens and then through the square mesh gauze. The disturbing action of the apparent diameter of the source of light as seen from the gauze causes the disappearance of the shadows in the plane perpendicular to the cylindrical lens. The mathematical theory of this phenomenon is of the greatest complexity and difficulty. At a moderate distance from the gauze the appearance is that of a brilliantly coloured striped cloth. Farther away the regular spectra are seen within and without the geometric shadow of the urries.

Prof. Edwin H. Hall read a paper on the "rotational co-efficient" in gold, iron, &c. The paper observed that the rotational co-efficient in gold is affected but slightly by change of temperature, if affected at all. In iron it is strongly affected, while the co-efficient is increased by tempering. The permanent magnetisation of steel effects a rotation.

SECTION A.

THE NATURE OF COMETS.

The first paper read in this section was by Prof. P. H. H. Vander Weyde, of Montreal, on "Some Suggestions on the Nature of Comets, with recent Astronomical and Electrical Discoveries."

That comets consist of clusters of solid bodies floating in space has been made highly probable by the connections traced between them and meteoric showers, while it is not contrary to telescopic and spectroscopic observations. The question arises as to what keeps their masses separate and prevents them from obeying gravitating attractions and falling together into one mass in their common centre of gravity. The recent revelation about the behaviour of what Crookes calls matter in the fourth state, under the influence of electric currents, and of the latter in vacuum tubes, and especially when acted upon by magnetic repulsion or attraction; also the consideration that a real vacuum is the best of all non-conductors,—all this suggests that the force which keeps the separate bodies constituting a comet apart may be a permanent electric charge, which cannot escape from the interplanetary medium, and is a good conductor. We can even imitate such an action in the air with a bundle of suspended light bodies, charged with static electricity. Such electrically charged clusters must be acted upon by the sun. The practical experiments with Crookes' tubes, and the actions upon them of magnets and bodies charged with static electricity, also suggest how the sun, which may as well exert electric as magnetic action, can cause changes in comets, and regulate the development of their tails, which always manifest a solar repulsion, very analogous to the repulsion by magnets of the luminous streams in vacuum tubes.

Mr. Winslow Upton, of the Army Signal Office, Washington, read a paper on "The Spectroscopic Rain-band."

Considerable attention has been bestowed on the variable lines in the spectrum due to atmospheric causes, especially to those due to the presence of aqueous vapour, which have been studied by Janssen, Secchi, Smyth, and others. These vapour lines vary with the amount of aqueous vapour, and hence can be taken as furnishing a measure of the amount present at different times. Regular observations have been made by myself with a Browning pocket spectroscope. The results obtained may be summarised:—

1. The rain-band is of value in estimating the amount of moisture present in the atmosphere.

2. Its indications follow in general those of psycerometer, but have the advantage of showing the moisture present in a large portion of the atmosphere, which advantage is occasionally of use.
3. It is of some use in foretelling rain, but must be used as any hygrometer and not as an infallible independent of other conditions.
4. Improvements in the instrument used are needed to increase its efficiency before it can be regarded as a meteorological instrument.

Prof. A. E. Dolbear then read a series of papers discussing electrical questions. The first, entitled "Electrical Conduction *versus* Induction," was a comparison of the phenomena exhibited in both these branches of the science. The broad conclusion deduced by the lecturer was that electricity was conducted by matter and not by air. The other papers were on the telephone as an explorer in an electric field, on vortex rising phenomena, and on telegraphing without wires.

Mr. Stephen S. Haight read a paper on "Danger from Lightning Increased by Telegraph Wires."

Last year he had seen a house struck by lightning and the eave-plates completely shattered. No other damage was done to the house, and the family experienced no evil effect more than a slight shock. At each end of the house was a lightning conductor, and those rods bore no marks. In front of the house was the pole of a telegraph line, which was stayed to the gate-post by a wire. This wire was melted, the gate-post uncased, and the gate itself broken. A deep furrow also ran from the gate to the brick sidewalk, where it ended in a deep hole. A tree in the course of the furrow was circled by the fluid and killed. Between this and the house no effects were visible, and the sole injury to the house itself was the destruction of the eave-plates. There was no doubt that the damage was caused by the stay wire, and that the hemlock trees attract the lightning more than deciduous trees.

Mr. George F. Barker read a paper on "Secondary Batteries." Much attention is now directed toward the cheapest possible method of producing electricity for the purpose of electric lighting. In this effort much time and study has been devoted by scientists to the devising of the best form of secondary battery, and the lecturer gave a brief account of experiments and research conducted by himself in this direction, with the object of discovering some method for facilitating the reversal of the electromotive force in batteries of this kind.

The thirty-first annual gathering of the American Association for the Advancement of Science was brought to an end by a complimentary excursion to Newport and Lake Memphremagog, given by the South Eastern Railway Company. The weather was fine and a most enjoyable day was spent. On returning to Newport hands were shaken and friends parted with the words, "We will not meet again until we assemble at Minneapolis."

The Electric Light in War.—We have received information that the British Electric Light Company has just taken in hand an order from the Admiralty to supply the following search light apparatus for war vessels: eight large "Gramme" machines to produce a light of 40,000 candles each, eight projectors, and eight hand lamps, as used in the late war.

Another Exhibition.—Another exhibition of electric and gas lighting is, we understand, to be held in St. James' Hall on December 11th next. Full particulars may be obtained from Mr. E. J. Cowlings Welsh, C.E., Palace Chambers, St. Stephen's, Westminster.

The Latest Discovery in Dynamo Machines.—Assuming, says the *World*, that the *Times* has discovered a new dynamo-machine, how will the discovery affect existing companies and their little ones? We should like to know that. It has long been our private opinion that these companies had started long before their time with "patents" most patently worthless, because the force they were trying to utilise was as yet but imperfectly under control, and the means of producing it but crudely developed. If the new machine which the *Times* says Sir William Thomson has patented is one-fifth the cost and much more efficient than any existing machine, companies which have no share in this invention will be in a bad way. But then next week somebody may distance Sir William Thomson; for he is not the exclusive electrical phenomena producer now living, by no means, and another inventor may devise a simpler lamp than any one knows of, with the result that the speculators, now in the full blaze of success, will in turn pass into oblivion. Where are we in this electric lighting and generating business, in short? Immense fortunes are about it somewhere, but hitherto they have been the promoter's fortunes only, and all we can see in this new machine at present, is a new crop of this, unless, indeed, the public be sick of the business.

Electric Lighting.—A portion of the interior of Windsor Palace is about to be illuminated by electricity. The preparatory operations are progressing.

On Wednesday week the Emperor and Crown Prince of Germany drove along the Leipziger Strasse, Berlin, to inspect the electric lighting of that thoroughfare. Both expressed themselves as highly pleased with the effect.

The Cowpen Local Board, at a meeting held last week at Waterloo, Blyth, resolved to memorialise the Board of Trade not to grant a licence to any company to light the district with the electric light. There was one dissenting vote.

The electric light now irradiates the streets of Hull.

Two electric lighting companies having notified to the Elgin Town Council that they purposed applying to the Board of Trade for a Provisional Order to supply the electric light within the jurisdiction of the council, that body has appointed a committee to look after the matter.

The Aberdeen Gas and Lighting Committee had under consideration last week no fewer than six circulars, from as many electric lighting companies, giving the necessary notifications of their intended applications for powers to supply the granite city with electricity. After deliberating for some time the Committee decided to remit to their Town Council the question, "Should they themselves not ask for a Provisional Order?"

At the Town Council-meeting on Monday the Clerk said the Town Council had received notices from the six following private companies of their intention to apply for Provisional Orders to authorise the supply of electricity within the district of the Town Council as local authority:—The Pilsen-Joel and General Electric Light Company, Limited; the Edison Electric Light Company, Limited; the Swan United Electric Light Company, Limited; the Hammond Electric Light and Power Supply Company, Limited; the Brush Electric Light and Power Company of Scotland, Limited; Messrs. Walter, Webb, & Co., solicitors, London. Notice of the following motion was given:—That the Town Council resolve to apply to the Board of Trade for a Provisional Order under the Electric Lighting Act, 1882, to authorise the Town Council as local authority under the said Act to supply electricity for any public or private purpose within the area or district of the Town Council as local authority under the said Act. After some discussion it was agreed to meet specially on the 6th November next and dispose of the question.

The Kintore Town Council are the recipients of a couple of letters asking their concurrence in applications about to be addressed to the Board of Trade for powers to supply electricity to their burgh.

The great Brooklyn bridge, which was begun in January, 1870, is slowly nearing completion, its opening for foot-passengers and vehicles being promised before the close of this year. It is intended that it shall be lighted at night by the electric light.

At the Fine-Art Exhibition, which opens at Dundee to-day, there is to be a display of the electric light "on a scale and with a completion never before attempted in Dundee."

A few weeks ago we announced the withdrawal of the Maxim light from the Edinburgh General Post-office. We now learn that there is a prospect of the "Brush" getting a trial there. The lighting of a number of the shops in Princes Street by the local company is also contemplated.

The electric light at the Munich Exhibition has been pronounced a great success.

The Town Council of Salisbury are not likely to oppose the application of the Edison Company to the Board of Trade for powers to supply their town with light.

The press rooms of the *Toronto Mail* are now lighted by electricity.

Eight companies have given the Birmingham Town Council notice of their determination to apply for Provisional Orders or licences to supply Birmingham with electricity. The Town Council are to consider the propriety of applying for a Provisional Order.

The electric light was introduced to Cambuslang on Tuesday evening last.

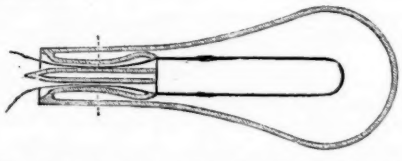
At the monthly meeting of the Banff Town Council, on Monday, notices of applications by the Brush, Hammond, and Swan companies for Provisional Orders to the Board of Trade were submitted. The deliverance of the Council was that they find they are not at present in a position to give consent to any of the companies.

The Berwick-on-Tweed Town Council have received the obligatory notice from several companies.

The Gülcher Electric Light Company.—On Tuesday evening last we paid a visit to the London Hospital, at the invitation of Mr. Charlewood, the secretary of the above company, for the purpose of inspecting an installation of the Crookes' incandescent electric lamps. These were burning during a conversazione which took place on the previous night, and had been pronounced a great success by the assembled company. In the dissecting room, which was gaily decorated and which was for the time devoted to more pleasurable scenes, were 40 incandescent lamps, arranged in 10 clusters of 4 each. These were supplied with the electric current from a Gülcher dynamo-electric machine, recently made by Messrs. Ransome & Co., of Chelsea, in whose premises it will be remembered the Gülcher system was first exhibited in England. This machine, which was constructed to supply 160 such lamps, was driven by a 14-horse-power nom. steam-engine, manufactured by Messrs. Ransome, Head, and Jeffries. The Gülcher system has already been fully described in the pages of the Electrical Review, so that it is quite unnecessary to say more concerning this part of the installation. The Crookes' incandescent lamp differs from others, we believe, in the details of construction only; it being claimed that the vacuum is more perfect, the carbon filament purer and more dense, and that the methods of manufacture render their production less costly.

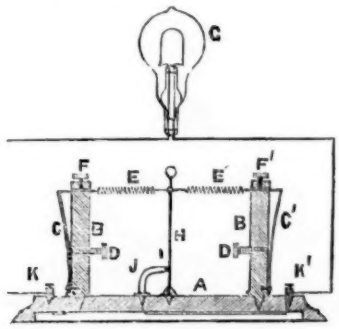
Instead of using platinum leading-in wires, Mr. Crookes employs a compound wire having a core of copper, and a sheathing only of the former very expensive metal. The filament of carbon is shaped very much in the style of the "Maxim," and the bulbs take the shape of large test tubes, instead of bulging out into the globular form. The Warden of the Hospital, to whose courtesy we are indebted for any information we required, expressed a hope that the time might come when that vast building would be entirely lighted by electricity in the place of gas. For such establishments, of course, its advantages strike one much more forcibly than in the case of ordinary households, although there it is most desirable. The general effect of the lamps was extremely good, and it is probable that had not the arrangements with the Gülcher Company been made at the last moment, the dynamo-electric machine might have been worked to its full capacity of 160 lamps. We may mention that the above company are the possessors of Mr. Crookes' various patents for incandescent electric lighting, for as this is one of the most recent lamps, the fact may not be generally known.

Electric Lamp.—Patent No. 263,011. Filed in the United States of America Patent Office, March 16th, 1882, by A. Bernstein.



Claim.—In an electric vacuum-lamp based on the principle of incandescence, the combination of a glass globe or bulb, a stopper sealed to the neck of the same and having a central evacuating-tube, and of conducting-wires which pass through the stoppers at the upper part thereof, the stopper being made of thin glass throughout and enlarged at the upper part, whereby nearly the same temperature is obtained in the upper part of the stopper as at the interior of the bulb, and thereby cracks and leakage prevented, substantially as and for the purpose set forth.

Safety Device for Electric Lamps.—Patent No. 262,423. Filed in the United States of America Patent Office, April 24th, 1882, by John H. Irwin.



Claim.—1. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, consisting of a spring having a resistance equal to the normal resistance of the circuit, adapted and arranged to be thrown out of circuit by another spring when the resistance of the main circuit is abnormally increased, substantially as described.

2. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, consisting of the springs, E E', rod, H, having a contact-piece, and the arm, J, with electrical connections, substantially as and for the purpose set forth.

3. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, having the springs, E E', provided with adjusting set-screws, F F', for securing said springs at the requisite tension, substantially as described.

4. In a safety device for electric lamps, base, A, posts, B, arms, C and C', set screws, D and F, rod, H, contact-piece, I, arm, J, and binding-posts, K and K', the whole combined and arranged to operate substantially as shown and described.

Soirée at Guy's Hospital.—On the evening of the 2nd instant the annual soirée was held, and the rooms used for the reception were illuminated by Messrs. Siemens Brothers with the electric light. Fourteen Siemens differential arc lamps were employed in the wards, staircases, passages and courtyard; while 71 Swan lamps were placed in the Anatomical Museum, and 10 more in the Electrifying room. The current was derived from a W_1 alternate current machine which, with its D_7 exciter, was mounted on a tumbril carriage and driven by a Marshall portable engine. The W_1 machine was arranged for three circuits, two being used for the arc lamps and the other for the Swan lamps. The guests at the soirée numbered about 2,000, and much admiration was expressed at the effect of the illumination.

Electric Lighting at Birmingham.—At the Birmingham Town Council held on Tuesday last, the Mayor read a communication from Messrs. R. W. Winfield and Co., offering to present to the Town Hall the fittings and lamps, valued at £2,000, which were used during the recent Musical Festival for lighting the Town Hall by the Crompton-Winfield electric light, on condition that the authorities purchased the cables connecting the fittings with Messrs. Winfield's works in Cambridge Street, at their cost price, £800. Messrs. Winfield also offered to undertake the supply of electricity to the Hall. The Mayor stated that the average cost of lighting the Hall by gas was a little under £3 per night, whereas the estimated cost by the Crompton-Winfield light was £12 10s. per night. The matter was referred to the Estates Committee.—*Times.*

Electric Lighting in Manchester.—On Tuesday evening, the 26th ult., the works of Mr. A. W. Richardson, engineer, Manchester, were illuminated by four electric lamps, the invention of Mr. Charles Lever, of Bowdon. We understand that the lamps worked admirably, and we hear from Mr. Lever that he contemplates exhibiting the same at the forthcoming Crystal Palace Exhibition. The lamps, of about 2,000 candle-power each, were worked by a

Marshall's four-horse vertical engine, the current being supplied by a Bürgin dynamo-electric machine. We are informed that Mr. Richardson, who has undertaken the construction of these lamps, has already been intrusted with a good order.

The Electric Light at Messrs. Bowyer and Priestley's Flour Mills, Buckden, near Huntingdon.—A permanent installation of the electric light by means of incandescence lamps has recently been completed at the above mills. The electric current is generated by a Siemens continuous current dynamo-electric machine capable of maintaining 60 incandescence lamps, a number of which are distributed in all parts of the mill, passages, engines and boiler house.

As the mill runs all night, the steady, brilliant, and colourless light is found very advantageous, enabling the attendants to the various machines to examine the quality of the flour the same as by daylight.

The contract was intrusted to Messrs. Charles Powis & Co., and we understand the light is giving great satisfaction.

Tenders Wanted.—The trustees of the Clyde Navigation have instructed their managers to obtain tenders for lighting the graving docks, Glasgow, and general terminus quay with the electric light; also for providing telephonic communication to different parts of the harbour.

The Edinburgh Failure Again.—Mr. F. T. Mappin, M.P., in addressing the shareholders of the Sheffield Gas Company the other day referred to the failure of the electric lighting systems at Edinburgh, and said he believed that until the price of the electric light came somewhat near that of gas the consumption of the former would not be very large. Mr. Mappin will probably soon have good reasons for modifying his ideas on this subject.

Laying a Cable in the Narrows.—A Correspondent has sent us the following cutting from an American newspaper: "The Baltimore and Ohio Telegraph Company has laid a cable across the Narrows from Fort Wadsworth to Fort Hamilton. A crossing so far down the bay was elected to avoid the danger of breakage or interrupted communication by ships dragging their anchors in stormy weather. The water at this point is very deep, and it is rarely or ever used by vessels as an anchorage. The tug-boat *Reba*, having in tow a scow that carried the cable, started from the pier at Fort Hamilton, and steamed across the bay. Among the passengers were R. Stewart, Superintendent of the Baltimore and Ohio Telegraph Company; C. W. Price, the New York manager; J. C. Haskinson, one of the road surveyors; Thomas T. Church, an old telegraph operator; and C. B. Hotchkiss. In the centre of the scow, coiled up on a large reel, was the cable, 6,500 ft. in length, and weighing 36,000 lbs. It contained seven copper conductors. Each wire has been given a coating of tin and covered with some insulating material. The seven wires have been bound together and encased in an armour of galvanised iron of the standard English No. 3 and American No. 2.

"The cable was manufactured by the Kerite Company, at its works in Seymour, Conn. It is $2\frac{1}{4}$ inches in diameter, and is the largest cable ever manufactured in this country. In comparison with English cables the insulation is heavier. Before landing the shore end the cable was tested by Mr. Price, for the Telegraph Company, and pronounced in good order. At 10.30 the shore end on the Staten Island side was made secure, and the word was given to start. For the first 1,000 ft. the wire was run out slowly, but as it became apparent that everything was in good working order the speed was increased, and in twenty-five minutes the crossing was made. Men stood by with water to prevent fire by friction, but their services were scarcely required, and the laying of the cable was pronounced a complete success. Some delay was occasioned in making fast the Long Island shore-end, because of the lowness of the tide, but by 1 o'clock everything was finished and communication between the two shores was established.

"The cable was laid under the direction of John Clark, who is a veteran in the service, most of the cables in this country having been laid under his instructions. Two smaller cables are to be laid, one between Tottenville and Perth Amboy, and the other between Perth Amboy and South Amboy. The line will then be complete to within a few miles of Philadelphia, and by October 15th the line is expected to be in operation."

Telegrams for Cairo.—The Eastern Telegraph Company notify the restoration of their direct wires to Cairo, and the re-opening of the business stations in that city. Telegrams written in code language are again accepted for all places in Egypt.

The Steam-ship "International."—The India-rubber, Gutta-percha, & Telegraph Works Company, notify the receipt of a telegram from Mr. Theophilus Smith, Engineer-in-charge, informing them that the s.s. *International* arrived at Gibraltar on Friday, the 29th, ult.

All well on board. After having filled up her bunkers with coal, she continued her voyage to Soussa, in Tunis.

Cultivation of Rubber-trees.—We read in the Panama *Star and Herald*, that the cultivation of cotton and rubber is receiving great encouragement at the hands of the Executive in the Republic of Guatemala. It is felt that the generalisation of various crops is preferable to paying attention to the cultivation of coffee alone, and measures are being adopted which it is expected will produce good returns. One of these has been the issue of a decree on the 10th inst., from which great results are expected. A premium of seventy-five dollars, payable in gold, is offered for every thousand rubber-trees which are planted. This premium will be paid directly the trees reach five years of age. In order to prevent the decree being taken advantage of, the government stipulates that the land planted shall not be above 1,000 ft. above the level of the sea; whilst so as to encourage planters, the State will furnish gratuitously the young plants required for setting out. The cultivation of cotton is also encouraged, and a premium of two dollars will be paid by the Republic during the next five years on each quintal of cotton exported. These different dispositions have been warmly approved by the public, who fully understand that the growth of many products by agriculturists will prevent the embarrassment which has been caused this year by the comparative failure of the coffee crop. The cultivation of cotton has long been fully understood, and no difficulty will, therefore, be experienced in spreading the growth of this valuable staple. With the india-rubber tree, however, matters are different; and it is doubtful if any correct thesis has been published which would be of value to those who might desire to invest capital in what promises to be a most successful enterprise. Correspondence is therefore solicited on the subject, and if any of our readers can supply information, the columns of the *Star and Herald* are always open for the publication of anything referring to this important industry.

Cable News.—Many of the daily papers of Thursday, the 28th ult., as we noticed last week, contained a short statement, headed "Completion of a New Atlantic Cable," or something to that effect. These statements, however, were, we need scarcely say, invariably very inaccurate. The facts are that Messrs. M. H. Gray, J. K. Gray, H. M. Walter, J. Bailey, junr., and J. Mathieson, junr., of the Engineering staff of the Silvertown Telegraph Company, with 31 cable-hands, and 6 stewards from the s.s. *Silvertown*, returned from Panama per Royal Mail s.s. *Nile*, after the completion of the Central and South American Telegraph Companies' cables from Chorillos (Peru) to Salina Cruz, Tehuantepec (Mexico).

Telegrams for Egypt, &c.—Telegraphic communication with all parts of Egypt has now been restored. Telegraphic communication to India, China, the East Indian Islands, South Africa, and Australia, by the route of the Eastern Telegraph Company, is re-opened.

Cable Repaired.—The cable between St. Thomas and St. Kitts is now repaired.

TIENTSIN AND CHEFOO.—A Shanghai telegram, dated August 29th, says telegraphic communication between Tientsin and Chefoo is about to be established.

TELEGRAMS FOR CHINA.—There is at present no telegraphic communication with Amoy, the cables between Shanghai and Amoy, and between Amoy and Hong Kong, being interrupted.

TELEGRAPH CABLE INTERRUPTED.—The cable between Fao and Bushire is interrupted.

ELECTRIC RAILWAYS.—Dr. Siemens is about to extend his electric railway system in Germany.

MANCHESTER MECHANICS' INSTITUTION.—The annual distribution of prizes gained by students of this institution was made on Monday by Mr. Oliver Heywood, in the presence of a distinguished audience. Mr. Martin, the teacher of the class in telegraphy, gained at the recent City and Guilds of London Technological Examinations the second prize of £5, and a silver medal in the honours grade. Mr. D. F. Dallas, in the ordinary grade, carried off a prize of £3 and a bronze medal. A noteworthy feature of the distribution was the presentation of certificates to the Misses Smith, of the Lancashire and Cheshire Telephone Company's Exchange, who are the first young women in the kingdom who have gained certificates from the City and Guilds of London.

UTILISING ELECTRIC CIRCUITS FOR VARIOUS PURPOSES.—On Thursday week Prof. Barratt, of Dublin, exhibited to the directors of the National Telephone Company, at their offices in Edinburgh, his system of utilising electric circuits for various purposes. We gave a short description of Prof. Barratt's system on page 408 of last volume.

PERSONAL.—It is with regret we learn that Mr. Spottiswoode (President of the Royal Society) has met with an accident and broken his arm. We are, however, glad to hear that he is doing well and hopes soon to be again about at his work. A number of our readers are doubtless aware that Mr. Spottiswoode has recently fitted up a very extensive set of apparatus to assist him in his inquiries into the principles which govern electric action. Any serious check to his labours is, therefore, to be deplored.

THE ELECTRIC LAUNCH.—The following particulars concerning the *Electric Launch* supplementing the information already made public in the columns of the *Times*, are supplied to us by Professor Silvanus P. Thompson :—The launch is built of iron except the decks and cabin fittings. Her length is a trifle over 25 ft. ; breadth of beam, 5 ft. ; draught, 1 ft. 9 in. forward, and 2 ft. 6 in. aft. She can hold 54 accumulators of the type described in the *Times*. The Corliss-Browne propeller is 20 in. in diameter with 22 inches clearance and 3 feet pitch. The screw makes 350 revolutions per minute, while the machines run at 900. The weight of the two Siemens dynamos is 640 lbs. : the accumulators weigh 1¼ tons. The calculated average speed is 9 miles per hour, which was indeed attained on the trial trip ; the speed being a little under 8 knots against the tide, and over 11 knots with the tide, though the belts slipped a little owing to their being new. The design and construction of the details of the boat are chiefly due to Mr. A. Reckenzaun, mechanical engineer to the Electrical Power Storage Company. After testing accumulators of the pattern used Prof. Thompson endorses the claim that they can furnish a current of 30 ampères for over 10 hours.

A GENTLE HINT.—The National Telephone Company gives public notice that during the winter months the progress of erecting telephone lines, owing to snow-storms, frost, &c., is much retarded, and suggests to those who are intending, during the course of the next six months, to become either subscribers to the Exchange, or renters of private wires, the desirability of giving in their orders now, to save delay and consequent disappointment.

NEW COMPANY REGISTERED.

ELECTRO-AMALGAMATOR COMPANY (LIMITED).—Capital £20,000, in £100 shares. Office : Tower Chambers, Finsbury Pavement. Objects : To purchase the letters patent No. 3,046, dated 28th June, 1882, granted to Richard Barker for the invention of a more profitable extraction of gold and silver by means of electricity. Signatories (with one share each) : Henry Beckwith, 96, Palmerston Buildings ; W. J. Tanner, 5, Argyll Road, Kensington ; G. Rudall, 3, Waterloo, Kilburn ; Henry Beckwith, Junr., Leyton ; R. S. Gladstone, Tower Chambers, Finsbury Pavement ; C. T. Gladstone, The Albany ; W. R. May (electrician), Malvern Road, N. Registered 27th September, by R. S. Fraser, 23, Moorgate Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

THE following returns have been recently filed :—

INDIAN AND ORIENTAL ELECTRICAL STORAGE AND WORKS COMPANY (LIMITED).—The return of this company, made up to the 25th of July, was registered on the 25th ult. The nominal capital is £400,000, in £5 shares. 30,000 shares have been subscribed for and £2 per share called up. The call has been responded to to the extent of £59,018, leaving £982 unpaid.

LONDON AND PROVINCIAL ELECTRIC LIGHTING AND POWER GENERATING COMPANY (LIMITED).—The return made up to the 21st September was registered on the 28th ult. The nominal capital is £250,000, in £5 shares. 13,813 shares have been taken up and the full amount called thereupon. The calls paid amount to £66,839 and unpaid to £2,226.

PROVINCIAL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return made up to the 23rd of August was filed on the 6th ult. The nominal capital is £200,000, in £5 shares. The number of shares taken up is 19,841, and a call of £2 10s. has been made. The calls paid amount to £44,189 10s. and unpaid to £5,413.

DEVON AND CORNWALL ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to the 20th ult., was filed on the same date. The nominal capital is £100,000, in £5 shares. 9,276 have been subscribed for and £2 10s. called thereupon, and 1,850 shares have been issued as fully paid. The calls paid amount to £18,902 and unpaid to £4,288.

CALLENDER'S BITUMEN TELEGRAPH AND WATERPROOF COMPANY (LIMITED).—The return of this company, made up to the 2nd of June, was filed on the 6th of June. The nominal capital is £40,000, in £10 shares, the whole of which have been subscribed for and paid up.

NEW PATENTS—1882.

4625. "Improvements in Planté's secondary batteries, and in apparatus connected with such or other batteries." ST. G. LANE-FOX. Dated September 28.

4645. "Electric meters." S. D. MOTT. Dated September 29.

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4661. "Means or apparatus for registering the supply of electricity." J. H. GREENHILL. Dated September 30.

4665. "An improved electro-motor." M. IMMISCH. Dated September 30.

4674. "Steam-engines and the operation of electrical generators thereby." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated October 2.

4676. "Improvements in incandescent electric lamps, and in the preparation of the carbon filament therefor." J. F. PHILLIPS. (Communicated by C. H. F. Müller.) Dated October 3.

4680. "Dynamo-electric and magneto-electric machines." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated October 2.

4691. "Improvements in the generation and distribution of electric energy, and in apparatus therefor." F. C. PHILLIPS. Dated October 2.

4694. "Machinery and apparatus for generating and utilising electricity." E. EDWARDS, A. F. ST. GEORGE, and H. L. PHILLIPS. Dated October 3.

4695. "Electric lamps." E. EDWARDS and A. F. ST. GEORGE. Dated October 3.

4696. "Electrical accumulators or secondary batteries." A. F. ST. GEORGE. Dated October 3.

4712. "Electric bells and alarm clocks, and apparatus to be used in connection therewith." B. W. WEBB and H. P. F. and J. JENSON. Dated October 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

700. "Generation, storage, and utilisation of electricity for lighting, &c." J. S. Williams. Dated February 13. 10d. The object of this invention is to construct apparatus and employ means to generate and utilise electricity more economically than hitherto, and comprises various improvements.

766. "Generation, storage, utilisation, &c., of electricity." J. S. Williams. Dated February 16. 4d. Has for its object the construction of apparatus for conserving or storing electric energy, and apparatus, methods, and means employed in connection therewith for generating, storing, and utilising electricity.

837. "Apparatus for collecting and storing electric currents." I. L. Pulvermacher. Dated February 21. 2d. According to this invention, the inventor recesses by a stamping or cutting process thin platinum, or other suitable metal in strip, sheet, plate, or other form, and coats or fills them with platinum sponge or platinum black, or it may be oxide of lead. These are arranged in a vessel capable of withstanding great atmospheric pressure. It is charged with a conducting liquid, and the lid is hermetically closed. (*Provisional only.*)

856. "Generation, storage, &c., of electricity." J. S. Williams. Dated February 22. 2s. 4d. The object of this invention is to generate, distribute, store, regulate, and utilise electricity for the working of railways and tramways and for other purposes, and it relates to methods, apparatus, and means employed therefor.

866. "Cables for telegraphic purposes, &c." J. C. Mewburn. (A communication from abroad by La Société Alamagny et Oriol of Paris.) Dated February 22. 2d. The improved machinery which forms the subject of this invention has for its object to facilitate the operation of covering with lead the wires or cables intended to be used as electric conductors for telegraphic or other purposes. (*Provisional only.*)

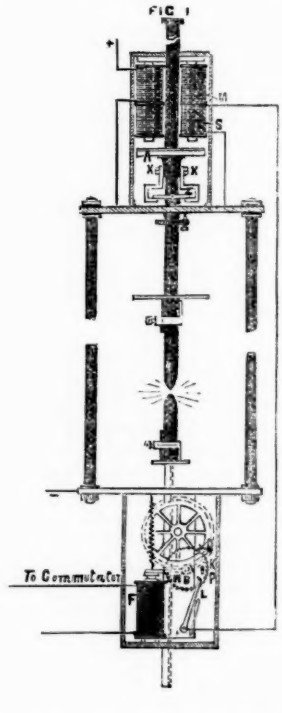
869. "Dynamo-electric machines, &c." C. E. Spagnoletti. Dated February 22. 6d. Has for its object improvements in dynamo-electric machines, for generating electricity for the purposes of electric lighting, plating, and transference of power, and other purposes.

872. "Electrodes." F. Des Vœux. (A communication from abroad by George Cumming and Clara Maria Brinkerhoff, both of New York, America.) Dated February 23. Relates to the periphery contact-key described in the No. of the Review for May 6th, 1882.

879. "Annunciator or indicator drop for telephone exchanges, &c." Magnus Volk. Dated February 23. 6d. Relates to the construction of an improved annunciator or indicator drop for telephone exchanges and the like, the object of the invention being to obtain great compactness with simplicity of construction and certainty of action.

880. "Electrical-signalling apparatus for communicating outbreak of fire." C. Spratt. Dated February 23rd. 8d. The object of this invention is to connect a central or district fire station with a number of outlying "posts," in such manner that from any post the fire call may be sent to the central station; and so also that the fire men first arriving at the post may be able to telegraph to the station for assistance if such should be required, or to communicate for any other purpose. The arrangement can also be applied to houses, shops, and public buildings. At the station a receiving instrument of the "step by step" type is provided. At each of the "posts" a "step by step" transmitter of peculiar construction is provided. The battery is at the station, and the line wires pass from the central station to the nearest post, thence to the next, and so on. In the receiving instrument there is an electro-magnet which, each time that the current is completed at either of the posts, attracts its armature. The armature works an escapement controlling an escapement wheel. The escapement wheel has an index fixed upon its axis and the reciprocating motion of the armature causes the index to pass around the dial. The dial is marked with the letters of the alphabet and some other signs, and on an outer circle with the names of the several "posts" or places. A key is provided for setting the index to zero; it operates mechanically by causing a lever to press upon a suitably-shaped cam on the same axis with the index. The first movement of the armature, by shifting a small finger or lever, closes a local circuit in which a bell is included, and the bell sounds. The zero key also acts on this finger to open the circuit at the same time that the index is set. There is also a plug circuit closed in the local bell circuit and the bell can be silenced when desired by withdrawing the plug. The battery which works the whole system is, as already stated, at the central station, and here, also, a finger key is provided which when depressed closes the circuit at the station and takes the battery off the line, and so as hereinafter explained indications can be given to the operator at the post. The transmitting instrument at each "post" consists of a revolving contact maker with the proper number of contacts to correspond with the receiving instrument; so that a complete revolution of the transmitting handle or wheel produces a complete revolution of the index on the dial. Each contact made by the transmitting instrument closes the circuit momentarily, the circuit normally (or when the instrument is at rest) being open. This revolving contact maker can either be turned by hand from letter to letter, or it can be geared with a train of wheel work and a spring or falling weight suitable for rotating it automatically. Except whilst the instrument is in use by an operator signalling letter by letter, the contact maker is always to be left geared up with the wheel work. The arrangement is such that the pulling out of a stop frees the wheel work and causes the contact maker to revolve the distance required to move the index at the receiving station until it points to the name of the "post" which signals. Thus the operator at the central station knows where the fire call comes from. The wheel work of the transmitter is stopped at the proper point either by electrical or mechanical mechanism. If electrical an electro-magnet is provided in the transmitting instrument, and when this attracts its armature it throws a pawl or stop into the teeth of a wheel on the driving train. To bring the electro-magnet into circuit one of the contact studs may be insulated and only connected through the coils of the magnet. Or when the revolving contact maker has reached the position required a cam surface in connection with it may effect the closing of the circuit through the electro-magnet. As the contact maker ought not to stop upon the contact, the wheel with which the stop pawl engages is not fast on its axis, but is connected by a coiled spring. The wheel has a slotted hole in it, receiving a pin which is carried round with the axis. The spring, which is in tension, forms a yielding link connecting the pin with the wheel, so that the train can run far enough to again open the circuit after the pawl has engaged. Or the driving train may be stopped mechanically at the proper place. This may be effected by the mere dropping of a tooth in a notch formed in a part revolving with the contact maker. In either case the fire alarm is given simply by drawing out a "pull" which withdraws the stop pawl or tooth from the wheel or part with which it engages. For verbal communication the driving train is thrown out of gear with the contact maker, and the contact maker moved round by hand step by step to the letters it is desired to transmit. In one position in which the contact maker can be placed the circuit is closed through a galvanometer, the needle of which consequently deflects. At the same time the position of the index at the station will show to the operator there that he can communicate with the "post," which he does by depressing his key. Each time that he does this the galvanometer needle will fall back, there being then no current on the line or through the galvanometer coils. In this way any prearranged signs may be given and information, if necessary, conveyed by the single needle code.

898. "Electric arc lamps." J. Brockie. Dated February 24. 8d. Has reference to various modifications in the construction of arc lamps forming part of the subject-matter of letters patent granted to the inventor, dated 19th September, 1879. According to the principles and construction of arc lamps, as described therein, it is proposed to give a periodical step-by-step feed to one of the carbon-holders in the lamp, by means of a commutator driven by the engine, electric machine, or other convenient motor, this rate of feed being based upon the average rate of consumption of the carbons employed, but in order to eliminate or provide against errors in the size of th



arc, consequent upon the said uniform and arbitrary feed, it is also proposed to re-adjust the arc at intervals, that is, after a stated number of impulses had been given to the feeding carbon-holder. The first part of this invention has reference to some mechanical details in the carrying out of the aforesaid principle, which render the action of the lamps so constructed more certain and satisfactory. The second part refers to some modifications in the principle of such step-by-step or independent feed lamps. The figure shows an elevation of the lamp constructed according to the first part of the invention. The mechanical details forming the subject of the first part of this invention are substantially as follows:—It is preferred to give the lower carbon-holder the step-by-step feed and to re-adjust the arc by means of the upper carbon-holder, as in

the figure, although this method may be reversed. But for the better understanding of the following description of the various plans under this invention, it will be taken as granted that the lower or negative holder is the one urged forward by the step-by-step movement; and that the re-adjustment of the arc is effected by the upper or positive holder. In the invention before cited it is proposed to accomplish the re-adjustment of the arc, after a certain number of impulses of the feeding magnet, by short-circuiting the main or arc-striking magnet; now it is found in practice it is much better to reverse its polarity. This is done, according to this invention, by winding the main magnet, M, differentially by a shunt coil, S, across the arc; but the said shunt coil, S, which reverses it, is only put momentarily in circuit at the readjusting periods. It is also proposed, in addition to this momentary reversal of the polarity of the main magnet, that another magnet wound in preferably the same shunt as the reversing coil be sometimes placed in opposition to the said main magnet, M, at *x*, though not shown in the drawing, in order to pull the armature, A, smartly away from the poles of the main magnet, as the residual magnetism or the over or under reversal of its polarity might prevent the armature retiring with that suddenness which is so essential to the proper performance of the lamp. A mechanical sudden contact arrangement, suitable for the said momentary periodical reversals of the main magnet, is substantially as follows, and is shown in fig. 1—viz., the magnet, F, which gives the step-by-step movement to the lower carbon-holder, also turns a ratchet wheel, W, substantially as described in previous patent referred to; but this wheel, W, is furnished with a projecting insulated boss, B, upon which a spring or lever, L, rests. An insulated pin, P, is placed near the outside of the said wheel, so that as the wheel revolves the pin, P, will lift the lever or spring, L, off the boss, B, and at a certain part of each revolution allow the spring to drop suddenly upon the boss, B, again; now a contact spring or pin, K, is placed on the said rotating wheel, W, occupying a position between the said insulated pin, P, and the boss, B, so that as the lever or spring falls from the insulated pin to the insulated boss it will rub or touch the said metal or contact spring or pin, K, momentarily. Now, this momentary contact completes the reversing coil, S (and opposing magnet, if any), as before described, and thus the arc will be re-adjusted to its correct length as the clutch, Z, will allow the carbons to meet and then lift the top carbon the correct distance. It will be seen that according to the foregoing method the feed and regulation of the lamps do not depend upon the variations in the length of the arc or the particular requirement of any lamp in a circuit, but the regulation is purely mechanical and arbitrary, although, of course, the rate of feed and the intervals of re-adjustment are based upon the well-ascertained rate of consumption and character of the carbons employed.

905. "Secondary batteries." J. W. Swan. Dated February 24. 4d. Has for its object the more economical production of lead in a finely divided state with a view to its use in connection with the pole plates of secondary batteries and also the construction of pole plates not liable to oxidation. In carrying out the first part of the invention the inventor takes galena or sulphide of lead in a finely divided state and reduces it to the state of metallic lead by acting upon it by hydrogen evolved in process of electro chemical action or by hydrogen evolved by chemical action. In the first case the inventor places it in contact with the negative or hydrogen pole of an electrolytic cell containing hydrochloric acid or other suitable electrolyte, and through which an electric current is passed until the required reduction of the lead to a metallic state is effected. The inventor sometimes promotes the decomposition by stirring the sulphide, either by moving the negative pole amongst the mass of sulphide and acid or other electrolytic liquid, or by employment of a stirrer unconnected with the poles. It is also proposed to effect the reduction of the lead sulphide to a metallic state by the chemical action of metallic zinc or metallic iron in contact with the sulphide and acid, and to promote the action by stirring and the application of heat. Having produced the finely divided lead in the manner described, the inventor applies it to the pole plates of secondary voltaic cells of the type of cells known as Planté's secondary cells to facilitate the formation of oxide of lead on one of the pole plates and the occlusion of hydrogen on the other of the pole plates.

922. "Transmitting and receiving audible signals by electricity." A. F. St. George. Dated February 25. 8d. Relates to apparatus used for the purpose of acoustical electric telegraphy or telephony, and it has for its objects novel methods of construction and arrangement of such apparatus so that it is more simple and effective, and at the same time cheaper in manufacture and working than apparatus for such purposes as heretofore ordinarily constructed and used.

943. "Machinery for obtaining continuous or alternating currents of electricity." Henry Edward Newton. (A communication from abroad by Alphonse Isidore Gravier, of Paris, in the Republic of France.) We shall refer to this apparatus fully in our next issue.

958. "Cutting and reeling paper for telegraphic purposes, &c." W. W. Colley. Dated February 27. 6d. Relates to apparatus for cutting a roll or web of paper of the usual width into strips suitable for use in recording and printing telegraphic instruments and for other purposes, and simultaneously reeling such strips.

985. "Apparatus for lighting gas by electricity, &c." C. L. Clarke and J. Leigh. Dated March 1. 6d. This invention relates to improvements upon the apparatus for which previous Letters Patent No. 2229 in the year of our Lord one thousand eight hundred and eighty and No. 245 in the year of our Lord one thousand eight hundred and eighty-one have been granted to the inventors; the first part of the said invention consisting in improvements in the general construction and arrangement of an electric lamp for lighting gas, and the second part of the same consisting in an improved battery which besides being specially adapted to the improved electric gas lighter is also applicable to other electrical appliances wherein a small portable battery is required.

CITY NOTES, REPORTS, MEETINGS, &c.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

At a meeting of the board of directors, held on the 4th inst., the accounts for the six months to the 30th June last were submitted, and showed a balance of £12,621 5s. 11d. on Revenue Account. The directors decided, after placing £5,000 to reserve, to carry the balance of £7,621 5s. 11d. forward. In consequence of the unusually heavy cost of repairs to cables during the past and current half years, the directors are unable to recommend a payment on account of the arrears of dividend on the Preference Shares.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

On the 29th ult., the eighteenth ordinary general meeting of the above company was held in Cannon Street Hotel, Neil Bannatyne, Esq., chairman of the company, presiding. There was only a small attendance of shareholders. The Manager, Mr. C. Gerhardi, having read the notice convening the meeting, the Chairman said: I suppose you will take the report and accounts as read. ("Agreed.") The report and accounts having been in your hands, and you having no doubt given them a careful perusal, I think there is nothing in them that requires any special remark before I propose the first resolution. The shareholders, I think, will have looked at the accounts, as the directors have done, with perhaps somewhat mixed feelings. As regards the increased traffic, we look upon that with great satisfaction. It has been steadily maintained from month to month throughout the half-year, with the exception of the month of May, during the greater portion of which month the Bilbao cable was interrupted. While we look at the increased traffic with great satisfaction, that is somewhat modified by the circumstance that we did not get the result which we would have anticipated from our increase of traffic, in consequence of our having had to repair the Bilbao cable, which you will see from the accounts has cost us no less a sum than £2,814 9s. 4d.; and although that amount is not in excess of what we anticipated we should have to pay, although we do not consider it unreasonable, yet it was such as very materially to reduce the balance of profit which otherwise would have been at our credit, and which we could have disposed of. If we had had no interruption during that month, we would have been able to pay the ordinary shareholders a much higher dividend than we are declaring to-day. We would also be able to add more to the reserve fund than what we recommend you to do to-day, and we would have carried forward a larger balance than what remains, as you will see from the accounts. Still I must say, that for myself, and I suppose my colleagues agree with me, that I consider that we are in a more satisfactory position now than we have ever been. We have a reserve fund of £6,000; we have a steady increase of traffic over what we ever received before, and our prospects are altogether better, I think, than they have ever been when we met you on any previous occasion. I trust we will have no interruption in either of our cables for some time to come, and if we have not we shall no doubt be in a position to pay the ordinary shareholders a considerably higher rate of dividend than we do now, and at the same time add most materially in the six months to our reserve fund, which we all consider a matter of the highest importance to the welfare of the company. I may just say that for the three months of the present half year, which will expire to-morrow, our receipts will show an increase of something like £700. We can scarcely expect to maintain that increase for the rest of the half year, because our receipts for the corresponding three months of last year were exceedingly good, more than £2,000 a month. If we can only have the same traffic as last year—I trust we shall have an increase—but if we only maintain our ground as to receipts we shall be in a better position than we have ever been. Of course that is contingent on the cable working the whole time. I may mention for your information, that the fault in the Bilbao cable was in about 90 fathoms of water, near the French coast. The cable on both sides of the fault was found to be in exceedingly good condition—as sound as when it was laid. In looking at the expenditure, I may remark that although there is an unavoidable increase in consequence of increased traffic, the proportion of expenditure is not higher than it has been. As compared with the receipts it will contrast very favourably with that of other companies doing the same description of traffic. The board will continue to give its efforts to keep down expenditure as far as is consistent with the proper working of the lines. We are making arrangements to have a special wire between London and Falmouth. This will really involve little or no extra expenditure, as the cost will be less than the amount which we at present pay to the Post-office, and we are certain that we can derive great advantage from that arrangement. As regards the payment of the dividend, I may say that we have received a telegram from Madrid stating that the balance of messages accounts for the second quarter of the present year may be expected to be received, at all events the greater portion of it, by about the 15th or 20th of October, and whenever it is received the dividend warrants will be issued at once. I really do not think there is anything else that I have to mention. Of course, if any shareholder has any question to ask we shall be very happy to reply and give any information to the best of our power. I beg leave to move the first resolution to this effect: That the report and accounts now presented be, and the same hereby are, received and adopted.

Mr. Abraham Scott seconded the resolution, which was then put to the meeting and carried unanimously.

The Chairman: The second resolution I have to propose is that the preference dividend, at the rate of 10 per cent. per annum, less income-tax, and a dividend of 3s. per share on the ordinary shares, free of income-tax, for the half-year ending the 30th June last be, and are, hereby declared.

Mr. Edmund Etlinger seconded the motion, which was likewise carried unanimously.

The Chairman: I do not know if the shareholders are aware that we are going to leave our present offices, and go into new ones, which will be very much nearer the centre of business, and altogether very superior offices to those which we now have, and no doubt when we have once got there it will contribute to the increase of our business. It will be far more handy for the greater number of our customers, and, altogether, it will be a decided advantage to the company, and will result in some increase of business. Our new offices will be at the corner of Leadenhall and Gracechurch Street, and we consider ourselves fortunate in getting such a good position.

Mr. W. Stimpson said that while this was a very successful piece of business, they must remember that the interests of the ordinary and of the preference shareholders, though identical in the matter of general success, were not quite identical in the division of the money. The ordinary shareholders had waited several years without getting any interest at all, and now when the takings were large, and the profits certainly proportionately so, they did think that by this time they should have got 5 per cent. There was wisdom, no doubt, in making a good reserve, but would it not be reasonable to hope that it should not be too largely increased when preference shareholders were getting 10 per cent out of the company. If the reserve increased to a very heavy amount, preferential shareholders would stand in a very fine position, but it would be somewhat at the expense of the interests of the ordinary shareholders.

The Chairman asked if the speaker could point out to the directors any way in which they could place the ordinary shareholders in a more satisfactory position? They could not help the advantages of the 10 per cent. preference shares. They had been glad to get them taken when they were, and any ordinary shareholder might take preference stock. It was as much the interest of the ordinary shareholder as of the preference that there should be a very large reserve. If they were to give them a larger dividend than they thought it at present prudent to do—then suppose the cable broke, and their reserve was so low that they could not repair it—the dividend would disappear altogether, and it would be very doubtful whether it would reappear again or not. The best practical proof of the importance of having a reserve fund was seen when their cable broke last. In consequence of having a reserve of upwards of £5,000, their shares only went down some 10s. or 15s. per share. But when, some years ago, the cable broke and there was only a small reserve fund, their shares went down to about £1 10s.; nobody, indeed, would have them. The fact of having a good reserve fund gave the ordinary shares a price in the market which they would not otherwise have borne, and people were content to pay that price and wait, with a moderate dividend, until the company was in a position to pay a higher dividend. Certainly the ordinary dividend at present was a very poor one upon the amount of paid up money upon the shares; yet a great many people held shares that were bought at £3, and, as far as they were concerned, 3s. per share was a very handsome return. Still he did not look upon that as a dividend likely to be normally paid. They expected, if they had anything like fair luck, to pay a very much larger dividend by-and-bye. But they could not alter the position of the ordinary and preferential shareholders. If they could get rid of the preference shares they should be very glad to do so, but no preference shareholder would give up his rights.

Mr. Stimpson said he had only risen to express the hope that the reserve would not be made too large at the expense of the ordinary shareholders; that they were not to be made the means by which the preferential shareholders should get their dividends as safe as consols while the ordinary shareholders were being a little bit starved.

The Chairman said that they were not the only company in which the same state of things as regarded share capital existed. The Cuba under similar circumstances had issued 10 per cent. preference shares, and it had been discussed in all manner of ways how to get rid of these shares since. The discussion, however, had never resulted in anything that was practicable.

Mr. M. Gray said that the neighbouring company to the Cuba had done otherwise.

The Chairman said that was because they were insolvent (laughter); they had come to the shareholders and said that there was no chance of getting preference dividends for many years to come; of course this company could do nothing of the kind.

Mr. Gray said that that was the case. There was no doubt that the preference shareholders had got a legal position, and a pretty strong one, and were never likely to give up their vantage ground. The having of a big reserve fund, no doubt, tended to give a greater market value to the preference shares, because it secured, in the eyes of investors, the payment of a dividend.

The Chairman said that that was inseparable from the constitution and issue of preference shares. They could not have got the capital raised but for these preference shares; they were glad to get it at the time, and they had no means of doing away with the conditions of issue. The ordinary shareholders got as much benefit from the reserve fund as the preference shareholders in the long run.

Mr. Stimpson said his only point was not to made the reserve fund too large.

The Chairman said that was a very fair question to raise, but they were a long way from considering that question yet. Looking at the cost of their cables and the amount of their reserve fund, they would find that they had a smaller reserve fund proportionally than any other company he knew of. If they wished this company to maintain a solid position they must continue to add to the fund every half year. When it did reach a considerably larger amount, then it might be for them to consider whether they could not reduce the half yearly addition to the reserve fund, but not till then. There was no other business before the meeting, and he would only thank those present for their attendance.

The proceedings then terminated.

THE JABLOCHKOFF ELECTRIC LIGHT AND POWER COMPANY.

Under the presidency of Mr. James Wilson, an extraordinary general meeting of the shareholders of the above-named company took place, on Tuesday afternoon, at the City Terminus Hotel, Cannon Street. The secretary, Mr. F. H. Reeves, having read the notice convening the meeting,

The Chairman said it was simply his business now to move that the special resolution, which was passed on the 15th of last month, "be, and is, hereby confirmed;" and as he had fully explained the importance of the suggested alterations, which were dictated by the Committee of the Stock Exchange before they would grant the company a settlement, he did not think it necessary to go further into the matter now. He begged then to move "That the articles of association be, and the same are, hereby altered as follows:—1. By the omission of articles 16, 20, and 31. 2. By the omission of the following words 'and the dividends, if any, forfeited therewith' from article 32. 3. By the omission of the word 'meeting' between the words 'such' and 'to' in article 48, and the insertion of the words 'business shall be given' instead thereof."

The motion, having been seconded by Mr. Tooley, was put to the meeting and carried, and the proceedings terminated.

HENLEY'S ELECTRIC LIGHT AND POWER COMPANY.

The statutory meeting of the shareholders of the above-named company was held at 4, Coleman Street, on Monday, Mr. Morgan Lloyd, Q.C., M.P., presiding.

The Chairman said: Ladies and gentlemen, we ought, properly speaking, to call upon the secretary to read the notice convening the meeting; but, as there is no copy of it in the room, perhaps you will take it as read. This is, as you know, what is called the statutory meeting of the company, required to be held by Act of Parliament, within four months after registration. At that meeting, as a rule, very little is considered, in fact, no business can very well be done at the first statutory meeting, because companies are very seldom indeed in a position to show any work done besides the starting, in so short an interval from the date of registration; and therefore what is usual is for the shareholders to meet together to receive a short statement in connection with the company's affairs up to that date. Now, gentlemen, I am sorry that I have not a great deal to say to you, because, owing partly to what some people call the long vacation, and others the "dead season," and others, a holiday, when people are out of town, it is difficult to get engineers, and even business men, to attend to business throughout that period. This company having come into existence not very long before the "dead season" commenced, there has been very little done. The directors have taken care that the money subscribed by the shareholders should not be used until it could be so profitably, and it is now in the bank, not one penny of it having been spent. Of course it is satisfactory to know that the money is safe; but you may naturally ask, "Well; why has not something been done?" One reason for that is this, that certain arrangements have not yet been completed which will enable the company to commence work on a business footing; but negotiations are going on which I believe are likely to result in a satisfactory manner. So far as the purchase of the business and of the patents from Mr. Henley is concerned, Mr. Henley has agreed with the company that until things are in such a condition as will fairly enable us to see our way to make the company a success, he will not ask for one shilling on any paid-up shares from the company. That, so far, shows what faith Mr. Henley has in his own inventions and in the value of his patents. We have had communications from two or three sources, and we have been offered a concession of very considerable value from one of the first Governments of the world (I am not at liberty now to mention the name of the country), but it one of the first of the great powers. The concessions are of considerable value, and are for lighting up some public works. The moment we find ourselves in a position to do so we shall take up the concessions. There have been applications also to Mr. Henley for dynamo machines, which we have not yet felt ourselves in a position to accept, but which remain open. The directors have been assisted most materially by the solicitor of the company, and are now in negotiations upon various matters; and I hope when we meet again, and perhaps long before we meet again as a company, that I shall be in a position to lay before you a satisfactory statement with regard to all those matters under negotiation, but in the meantime I must ask you to trust your directors with the business. We are doing what we can to mature matters, and when they are so matured we shall take you entirely into our confidence. We have been asked to keep private certain names, and until the contracts are completed we have no right to make them public. I may tell you this, gentlemen, that for the present or until we are in a position to commence business, we have taken care that no expenses should be incurred; offices are supplied to us for nothing by our solicitor. The secretary for the present does his work gratuitously, believing that the company will be a success and the time will come when he will be paid. We have incurred no expense, and it is intended to incur none until we find we are in a position to commence business. That, I think, is all I have to tell you.

The proceedings concluded with a vote of thanks to the chairman, proposed by Mr. B. L. Baynham, seconded by Mr. Ball.